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TITLE

USER'S GUIDE FOR SHIPINT - A COMPUTER PROGRAM TO COMPUTE TWO SHIP INTERACTION IN WAVES

System Number:

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Requester:

Notes:

DSIS Use only:

Deliver to:

National Defence Research and Development Branch

Défense nationale Bureau de recherche et développement

DREA CR/96/445

USER's GUIDE FOR **SHIPINT** — A COMPUTER PROGRAM TO COMPUTE TWO SHIP INTERACTION IN WAVES

by
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CONTRACTOR REPORT

Prepared for

Defence Research Establishment Atlantic

Centre de Recherches pour la Défense Atlantique

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W7707-5-3254/01-HAL
Contract Number

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Abstract

The computer program SHIPINT has been developed for the coupled motion computations of two adjacent ships advancing on a parallel course in regular or irregular waves. The code is written in Fortran 77 ANSI.

The coupled motion computations use the three-dimensional panel method, and the zero-speed Green function with a simple forward speed correction. With this method, the field points and source points are all distributed on the wetted surfaces of two ships (ship-a and ship-b). The hydrodynamic forces, wave exciting forces and motions are computed based on two ship interaction. The double body flow model is applied to obtain the steady flow disturbance potential and velocity distributions on the wetted surface on ship-a and ship-b by the Hess-Smith method. The m-terms are computed by the integral equation method based on double body flow of two ship interaction. The approximate m-terms can also be used in this program. Schmitke's method is used to compute the viscous roll damping coefficients for ship-a on its own, and ship-b on its own; therefore, the viscous interaction effect is not considered. The spectral analyses are carried out for ship-a and ship-b.

Input and output files, and examples are also presented and described in detail in this guide.

Résumé

Le programme SHIPINT a été développé pour les calculs des mouvements couplés de deux navires avançant côte à côte sur des trajectoires parallèles en houle régulière ou irrégulière. Ce code est écrit en Fortran 77 norme ANSI.

Les calculs des mouvements couplés utilisent la méthode par facettes tri-dimensionnelles, la fonction de Green du problème sans vitesse d'avance et une correction simple pour la vitesse d'avance. Avec cette méthode les points de contrôle sont tous répartis sur la partie mouillée des carènes des deux navires (navire a et navire b). Les efforts hydrodynamiques, les efforts dus à la houle et les mouvements des navires sont calculés en prenant en compte l'interaction entre les deux navires. Un calcul double modèle est effectué pour obtenir le potentiel de pertubation stationnaire ainsi que la distribution de la vitesse sur la surface mouillée du navire a et du navire b (méthode de Hess et Smith). Les "m-terms" sont calculés par une méthode intégrale basée sur l'écoulement obtenu pour le problème du double modèle pour les deux navires en interaction. Les "m-terms" ainsi approximés peuvent aussi être utilisés par ce programme. On utilise la méthode de Schmitke pour calculer les coefficients d'amortissement en roulis pour chacun des deux navires pris séparément. L'effet visqueux de l'interaction n'est pas pris en compte. Les analyses spectrales sont faites pour le navire a et pour le navire b.

Ce manuel présente aussi des fichiers de données et de resultats ainsi que des exemples décrits en détail.

Contents

1 Introduction

This document is a User's Guide for a computer program called SHIPINT, which computes the motions of two ships interacting in waves.

When using this document, reference should be made to the SHIPINT Final Report [1], PANELGEN User's Guide [2], and SMCA4 Reports [3][4].

2 Coordinate Systems and Two Ship Motions

Three steady moving coordinate systems $oxyz$, o_a-$x_a y_a z_a$ and o_b-$x_b y_b z_b$ are used as shown in Fig.1. The coordinate systems are moving in the positive x direction with a ship steady forward speed U. The planes, xoy, $x_a o_a y_a$ and $x_b o_b y_b$, coincide with the calm water surface, the planes yoz and $y_a o_a z_a$ are at amidships of ship-a and the plane $y_b o_b z_b$ is at amidships of ship-b. The right-hand coordinate systems are used in this program.

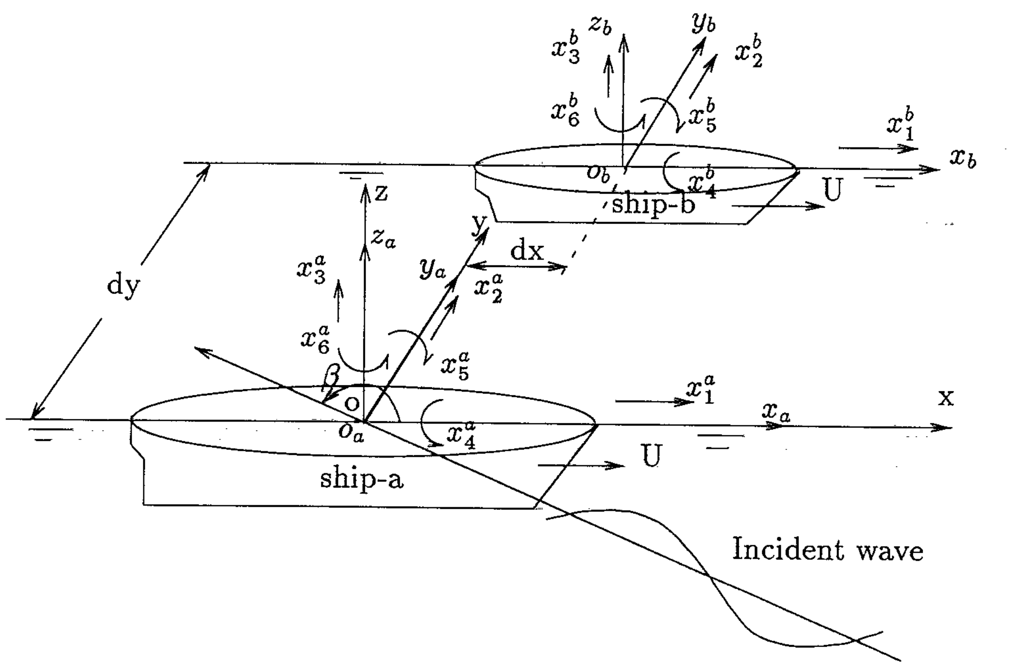

Figure 1: Coordinate Systems and Ship Motions

In Figure 1, x_1^a is the surge motion, x_2^a sway, x_3^a heave, x_4^a roll, x_5^a pitch and x_6^a yaw for ship-a and x_1^b is the surge motion, x_2^b sway, x_3^b heave, x_4^b roll, x_5^b pitch and x_6^b yaw for ship-b, respectively. The incident wave propagation direction is also shown in Fig.1, where β is the heading angle between the wave propagation direction and the positive x-axis direction.

3 Flow Chart

The flow chart of the program SHIPINT is shown in Figure 3.

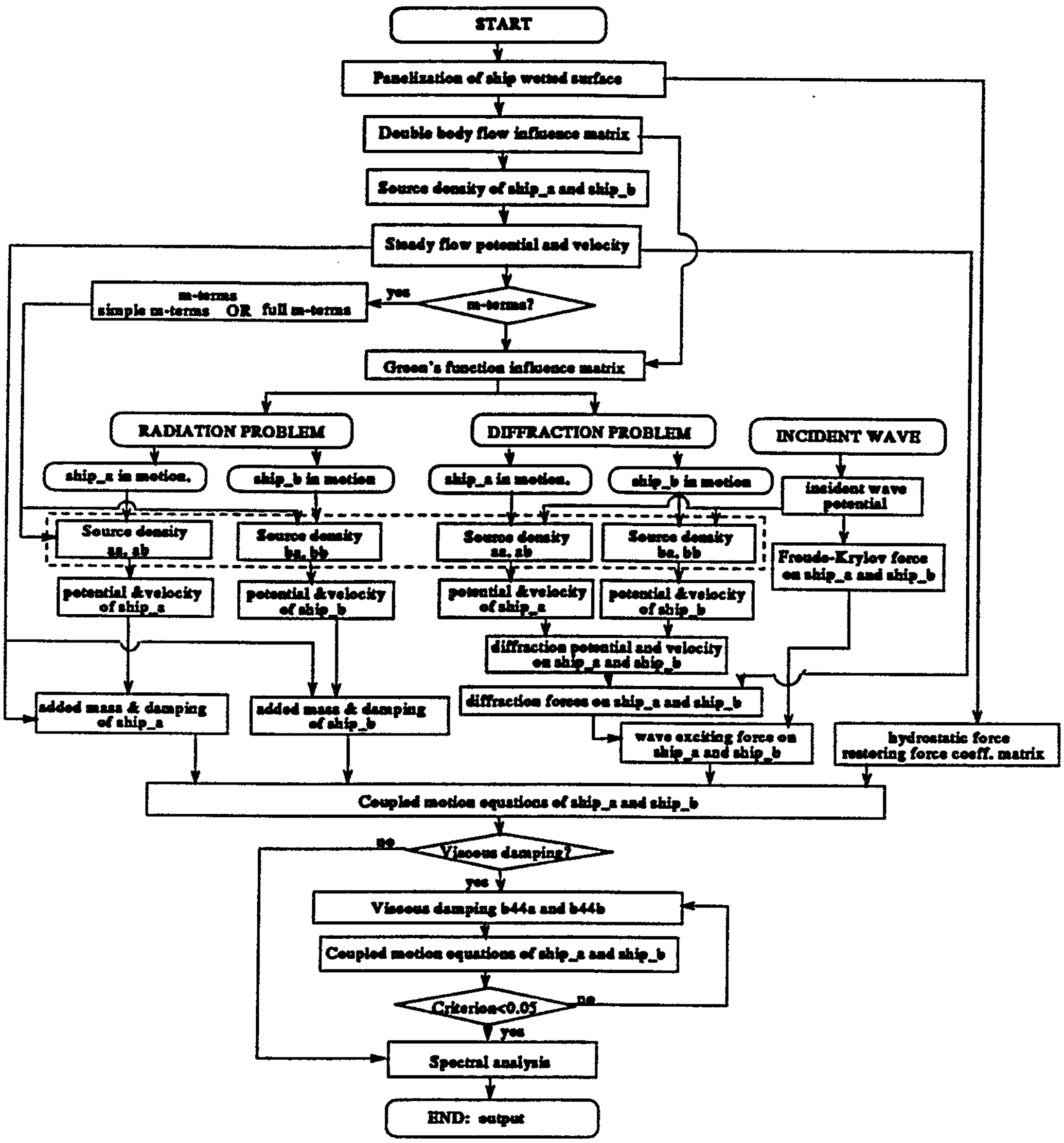

Figure 2: Flow Chart of SHIPINT

4 Input Data File Description

There are six input data files, **shipint.in, panel_a.in, panel_b.in, vdamp_a.in, vdamp_b.in** and **spetrum.in**. The **shipint.in** is for two ship principal particulars, centre of gravity, moments of inertia, separation distance, incident wave information and controlling the computation of m-terms and viscous roll damping coefficients. The **panel_a.in** and **panel_b.in** are the geometrical information of panels for ship-a and ship-b. The **vdamp_a.in** and **vdamp_b.in** are the input data of viscous roll damping coefficient computation for ship-a and ship-b. the **spetrum.in** is the irregular wave parameter for spectral analysis.

At the beginning of the program, two parameters must be determined in the parameter statement:

$$parameter(maxn\_panel = 220, maxn\_panel = 320)$$

maxn_panel :	total number of panels on the whole wetted surface for the ship with the greatest number of panels.
maxn_node :	total number of nodal points on the whole wetted surface for the ship with the greatest number of nodal points.

If the actual panel number or nodal number exceed the specified default values ($maxn\_panel = 220, maxn\_panel = 320$), the parameters in above statement need to be modified accordingly.

4.1 shipint.in

The file **shipint.in** provides the necessary data for the ship's principal dimensions for two ships, the regular incident wave parameters and computation condition. In the file **shipint.in**, the following information must be provided:

Record(a), Date of Computation

date (alphanumeric characters)

date : date of computation, up to 20 alphanumeric characters with single-quotation marks, e.g. 'May 17, 1996'

Record(b), Ship-a Principal Particulars

namea, *filea* (alphanumeric characters)
sla, *sba*, *sta*, *vola*, *cba* (5 real numbers)
xga, *yga*, *zga* (3 real numbers)
ri44a, *ri55a*, *ri66a* (3 real numbers)

namea :	ship-a identification, up to 80 alphanumeric characters with single-quotation marks, e.g. 'AOR'
filea :	the input data file of panel information for ship-a
sla :	ship-a length between perpendiculars (m)
sba :	ship-a beam (m)
sta :	ship-a draught (m)
vola :	volume displacement of the ship-a (m^3)
cba :	block coefficient of ship-a
xga :	x-coordinate of c.g. of ship relative to midships (m), in o_a-$x_a y_a z_a$ coordinate system.
yga :	y-coordinate of c.g. of ship relative to centerline (m) in o_a-$x_a y_a z_a$ coordinate system.
zga :	z-coordinate of c.g. of ship relative to calm waterline (m) in o_a-$x_a y_a z_a$ coordinate system.
ri44a :	roll radius of gyration of the ship-a (m), in o_a-$x_a y_a z_a$ coordinate system.
ri55a :	pitch radius of gyration of the ship-a (m), in o_a-$x_a y_a z_a$ coordinate system.
ri66a :	yaw radius of gyration of the ship-a (m), in o_a-$x_a y_a z_a$ coordinate system.

Record(c), Ship-b Principal Particulars

nameb, *fileb* (alphanumeric characters)
slb, *sbb*, *stb*, *volb*, *cbb* (5 real numbers)
xgb, *ygb*, *zgb* (3 real numbers)
ri44b, *ri55b*, *ri66b* (3 real numbers)

nameb :	ship-b identification, 80 alphanumeric characters with single-quotation marks, e.g. 'MCDV'
fileb :	the input data file of panel information for ship-b
slb :	ship-b length between perpendiculars (m)
sbb :	ship-b beam (m)

stb :	ship-b draught (m)
$volb$:	volume displacement of the ship-b (m^3)
cbb :	block coefficient of ship-b
xgb :	x-coordinate of c.g. of ship relative to midships (m), in o_b-$x_b y_b z_b$ coordinate system.
ygb :	y-coordinate of c.g. of ship relative to centerline (m) in o_b-$x_b y_b z_b$ coordinate system.
zgb :	z-coordinate of c.g. of ship relative to calm waterline (m) in o_b-$x_b y_b z_b$ coordinate system.
$ri44b$:	roll radius of gyration of the ship-b (m), in o_b-$x_b y_b z_b$ coordinate system.
$ri55b$:	pitch radius of gyration of the ship-b (m), in o_b-$x_b y_b z_b$ coordinate system.
$ri66b$:	yaw radius of gyration of the ship-b (m), in o_b-$x_b y_b z_b$ coordinate system.

Record(d), Location of ship-b relative to ship-a

dy, dx (2 real numbers)

dy :	transverse location of ship-b relative to ship-a (+port)(see Fig.1)
dx :	longitudinal location of ship-b relative to ship-a (+forward)(see Fig.1)

Record(e), ship speed

U (real number)

U : steady forward speed for both ship-a and ship-b(m/s)

Record(f), Incident Wave Parameters (Wave Heading Angles)

$nangle$	(integer)
$wangle(1)$	(real number)
$wangle(2)$	(real number)
....	.
....	.
$wangle(nangle)$	(real number)

$nangle$: total number of incident wave headings

wangle(i) : wave direction (degrees) relative to ship speed (180 degrees for head seas), i=1,2,...,nangle

Record(g), Incident Wave Parameters (Wave Frequencies)

$nw1$	(integer)
$wslr(1)$	(real number)
$wslr(2)$	(real number)
....	.
....	.
$wslr(nw1)$	(real number)

nwl : total number of wave length to ship length ratios

wslr(i) : wave length to ship length ratios, i=1,2,...,nwl

Record(h), Control Parameters

kdamp, *kmterm* (2 integers)

kdamp : if kdamp=1, the viscous damping coefficient computation is performed; if kdamp=0, the viscous damping coefficient computation is not performed.

kmterm : if kmterm=1, the double body m-term effect computation is performed; if kmterm=0, the simplified m-term effect computation is performed.

As an example, **shipint.in** for AOR and MCDV is given as follows:

Record (a)	:	May 28, 1996
Record (b1)	:	'AOR' 'panel_a.in'
Record (b2)	:	162.46 23.16 9.144 20833.82 0.6
Record (b3)	:	0.0 0.0 -0.8
Record (b4)	:	9.032 40.615 40.615
Record (c1)	:	'MCDV' 'panel_b.in'
Record (c2)	:	52.00 10.76 3.4 1065.89 0.5603
Record (c3)	:	-0.86 0.0 1.01
Record (c4)	:	3.67 14.56 14.56
Record (d)	:	33.92 0.0
Record (e)	:	5.144
Record (f1)	:	7
Record (f2)	:	45.
Record (f3)	:	90.
Record (f4)	:	135.
Record (f5)	:	180.
Record (f6)	:	225.
Record (f7)	:	270.
Record (f8)	:	315.
Record (g1)	:	13
Record (g2)	:	0.2
Record (g3)	:	0.35
Record (g4)	:	0.5
Record (g5)	:	0.65
Record (g6)	:	0.8
Record (g7)	:	0.95
Record (g8)	:	1.1
Record (g9)	:	1.25
Record (g10)	:	1.4
Record (g11)	:	1.55
Record (g12)	:	1.7
Record (g13)	:	1.85
Record (g14)	:	2.0
Record (h)	:	1 1

4.2 panel_a.in and panel_b.in

The input data files **panel_a.in** for ship-a and **panel_b.in** for ship-b provide the information of panels and nodal points. These two data files have the same format.
The mean wetted hull surface of a ship is divided into a finite number of quadrilateral panels. The nodes are arranged in such a way that if we look at the panels from outside of the hull, the nodal order is clockwise as shown in Fig.3.

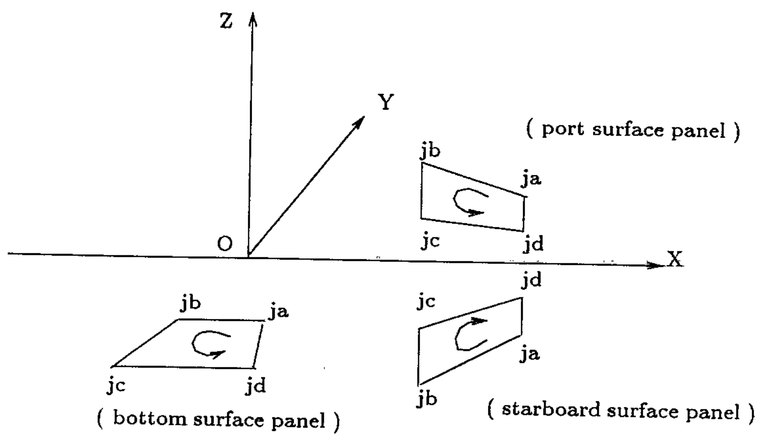

Figure 3: Connectivity Information on Panels

In **shipint_2.in** and **shipint_3.in**, the following data must be provided:

Record(a), Nodes and Panels on Ship Surface

np, ne (2 integers)

1	x(1)	y(1)	z(1)	(1 integer, 3 real numbers)
2	x(2)	y(2)	z(2)	
3	x(3)	y(3)	z(3)	
..	..	..	..	
I	x(I)	y(I)	z(I)	
..	..	..	..	
np	x(np)	y(np)	z(np)	

1	j(1,1)	j(2,1)	j(3,1)	j(4,1)	(5 integers)
2	j(1,2)	j(2,2)	j(3,2)	j(4,2)	
3	j(1,3)	j(2,3)	j(3,3)	j(4,3)	
..	..	..	..	..	
J	j(1,J)	j(2,J)	j(3,J)	j(4,J)	
..	..	..	..	..	
ne	j(1,ne)	j(2,ne)	j(3,ne)	j(4,ne)	

np : total number of nodes
ne : total number of panels
$x(I)$: nodal x-coordinates relative to midships (m)
$y(I)$: nodal y-coordinates relative to centerline (m)
$z(I)$: nodal z-coordinates relative to calm waterline (m)
$j(I,J)$: connectivity information, providing four nodal indices on each panel. The nodes are arranged as shown in Figure 3. J: panel index

As an example, **panel_a.in** for AOR is given as follows:

Record (a)	: 252 200			
Record (a1,1)	: 1	81.250000	0.000000	0.000000
Record (a1,2)	: 2	73.125000	-1.95121	0.000000
Record (a1,3)	: 3	65.000000	-3.81250	0.000000
Record (a1,4)	: 4	56.875000	-5.61890	0.000000
Record (a1,5)	: 5	48.750000	-7.23672	0.000000
Record (..)	: ..	....	....	....

Record (..)	:	..	....	....	....	
Record (..)	:	..	....	....	....	
Record (..)	:	..	....	....	....	
Record (a1,248)	:	248	-48.750000	0.000000	-9.14634	
Record (a1,249)	:	249	-56.875000	0.000000	-9.14634	
Record (a1,250)	:	250	-65.000000	0.000000	-9.02439	
Record (a1,251)	:	251	-70.687500	0.000000	-6.70731	
Record (a1,252)	:	252	-70.579269	0.000000	-6.67683	

Record (a2,1)	:	1	1	22	23	2
Record (a2,2)	:	2	2	23	24	3
Record (a2,3)	:	3	3	24	25	4
Record (a2,4)	:	4	4	25	26	5
Record (a2,5)	:	5	5	26	27	6
Record (..)	:	..	....	....	....	....
Record (..)	:	..	....	....	....	....
Record (..)	:	..	....	....	....	....
Record (..)	:	..	....	....	....	....
Record (a2,196)	:	196	226	227	248	247
Record (a2,197)	:	197	227	228	249	248
Record (a2,198)	:	198	228	229	250	249
Record (a2,199)	:	199	229	230	251	250
Record (a2,200)	:	200	230	231	252	251

As an example, **panel_b.in** for MCDV is given as follows:

Record (a)	:	312 212			
Record (a1,1)	:	1	24.200001	0.000000	-3.400000
Record (a1,2)	:	2	23.400000	0.000000	-3.400000
Record (a1,3)	:	3	20.799999	0.000000	-3.400000
Record (a1,4)	:	4	18.200001	0.000000	-3.400000
Record (a1,5)	:	5	15.600000	0.000000	-3.400000
Record (..)	:	..	....	....	....
Record (..)	:	..	....	....	....
Record (..)	:	..	....	....	....
Record (..)	:	..	....	....	....
Record (a1,308)	:	308	-13.000000	0.500000	-2.600000
Record (a1,309)	:	309	-15.600000	0.500000	-2.150000
Record (a1,310)	:	310	-18.200001	0.500000	-1.720000

Record (a1,311)	:	311	-20.799999	0.400000	-1.250000	
Record (a1,312)	:	312	-23.400000	0.000000	-1.100000	

Record (a2,1)	:	1	1	2	15	14
Record (a2,2)	:	2	2	3	16	15
Record (a2,3)	:	3	3	4	17	16
Record (a2,4)	:	4	4	5	18	17
Record (a2,5)	:	5	5	6	19	18
Record (..)	:	..	....	....	....	....
Record (..)	:	..	....	....	....	....
Record (..)	:	..	....	....	....	....
Record (..)	:	..	....	....	....	....
Record (a2,208)	:	208	299	307	308	300
Record (a2,209)	:	209	300	308	309	301
Record (a2,210)	:	210	301	309	310	302
Record (a2,211)	:	211	302	310	311	303
Record (a2,212)	:	212	303	311	312	304

4.3 vdamp_a.in and vdamp_b.in

The input data files **vdamp_a.in** for ship-a and **vdamp_b.in** for ship-b provide all the necessary data to compute the bilge keel, eddy-making, friction, lifting and appendage damping coefficients, whenever available, and also the resultant viscous damping coefficient.

Record(a), Control Parameters

IBK, IBE, IBF, IBA, IBL (5 integers)

IBK :	if $IBK = 1$, the bilge keel viscous roll damping coefficient is computed; if $IBK = 0$, the bilge keel viscous roll damping coefficient is not computed.
IBE :	if $IBE = 1$, the eddy-making viscous roll damping coefficient is computed; if $IBE = 0$, the eddy-making viscous roll damping coefficient is not computed.
IBF :	if $IBF = 1$, the friction viscous roll damping coefficient is computed; if $IBF = 0$, the friction viscous roll damping coefficient is not computed.
IBA :	if $IBA = 1$, the appendage (other than bilge keel) viscous roll damping coefficient is computed; if $IBA = 0$, the appendage (other than bilge keel) viscous roll damping coefficient is not computed.
IBL :	if $IBL = 1$, the lifting viscous roll damping coefficient of rudder and skeg is computed; if $IBL = 0$, the lifting viscous roll damping coefficient of rudder and skeg is not computed.

Record(b), Ship Parameters, Water Properties

ns, $ns0$, $ns1$ (3 integers)

ns :	total number of sections.
$ns0$:	index of the section where the bilge keel starts.
$ns1$:	index of the section where the bilge keel ends.

Record(c), Water Properties

rho, mu (2 real numbers)

rho :	density of water (kg/m^3).
mu :	kinematic viscosity of water (m^2/s).

Record(d), Bilge Keel Information

b_k, bk_l (2 real numbers)

b_k:	bilge keel breadth (m).
bk_l:	bilge breadth-length ratio.

Record(e1), Sectional Parameters

For sections $i = 1$ to ns:

$Ship\_I(i), Ship\_S(i), Ship\_B(i), Ship\_KG(i), Ship\_d(i)$ (5 real numbers for each section)

$Ship\_I(i)$	the sectional shape identifier. for V or U-shaped section, $Ship\_I = 1$. for full-almost rectangular section $Ship\_I = 2$. for triangular section, $Ship\_I = 3$.
$Ship\_S(i)$	wetted surface area at section i (m^2) (Figure 4).
$Ship\_B(i)$	sectional beam (m).
$Ship\_KG(i)$	height of ship's C.G. above the lowest point at each section (m).
$Ship\_d(i)$	sectional draught (m).

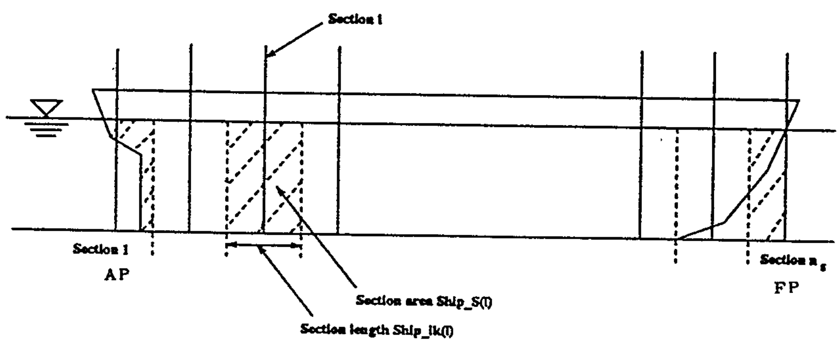

Figure 4: Sectional Length and Area

Record(e2), Sectional Parameters

For sections $i = 1$ to ns:

$Ship\_rhat(i), Ship\_a(i), Ship\_r(i), Ship\_rb(i), Ship\_lk(i)$ (5 real numbers)

$Ship\_rhat(i)$	distance from ship's C.G. to the point where eddies are shed, in the yz plane (m).
$Ship\_a(i)$	the inclination angle (relative to vertical) of ship side at the section waterline (deg) (Figure 5).
$Ship\_r(i)$	distance from C.G. to the center of the bilge keel at each section (m); if no bilge keel, set value to zero.
$Ship\_rb(i)$	section bilge radius (m) (Figure 5).
$Ship\_lk(i)$	section length (m) (Figure 4).

Record(e3), Sectional Parameters

For sections $i = 1$ to ns:

$Ship\_G(i), Ship\_ss(i), Ship\_F\_r(i), Ship\_a\_g(i)$ (4 real numbers)

$Ship\_G(i)$	angle about CG between waterline and bilge keel root (rad) (Figure 6).
$Ship\_ss(i)$	length of girth from the bilge keel root to waterline (m) (Figure 5).
$Ship\_F\_r(i)$	sectional dead-rise (m) (Figure 5).
$Ship\_a\_g(i)$	the angle made by the plane of the bilge keel with the straight line passing through C.G. and the bilge keel root (rad) (Figure 6).

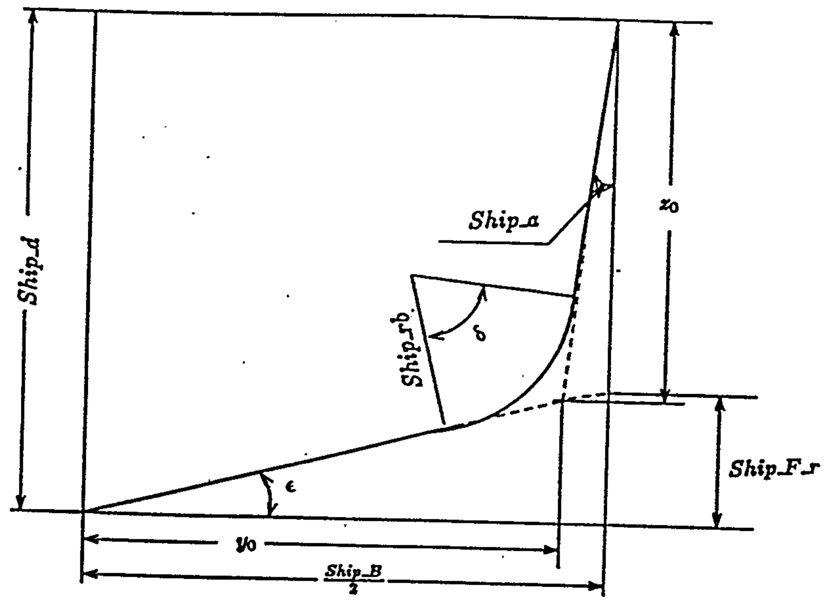

Figure 5: Sectional Parameters

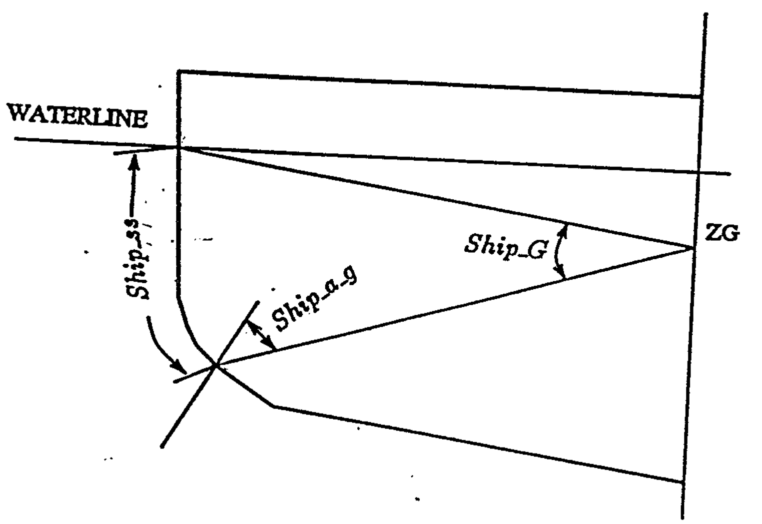

Figure 6: Bilge Keel Parameters

Record(f), Rudder and Deadwood Parameters

b_s, h_CG, b_R, $sigma$, S_R (5 real numbers)

b_s	skeg span (m) (Figure 7).
h_CG	vertical distance of C.G. above waterline (m) (Figure 7).
b_R	rudder span (m) (Figure 7).
$sigma$	skeg angular parameter (rad) (Figure 7).
S_R	rudder area of single side (m^2).

Record(g1), Parameters of Appendages Other Than Bilge Keel

na, c_n (1 integer, 1 real number)

na	total number of appendages.
c_n	normal force coefficient for a flat plate inclined at a large angle to the flow. See Schmitke's work [3].

Record(g2), Parameters of Appendages Other than Bilge Keel

For appendage $i = 1$ to na:

$App\_y(i), App\_z(i), App\_G(i), App\_C\_e(i), App\_C\_r(i), App\_Bar\_B(i)$ (6 real numbers)

$App\_y(i)$	y-coordinate at root of appendage i (m) (Figure 8).
$App\_z(i)$	z-coordinate at root of appendage i (m) (Figure 8).
$App\_G(i)$	appendage dihedral angle (deg) (Figure 8)
$App\_C\_e(i)$	end chord of appendage i (m) (Figure 9).
$App\_C\_r(i)$	root chord of appendage i (m) (Figure 9).
$App\_Bar\_B(i)$	span of appendage i (m) (Figure 9).

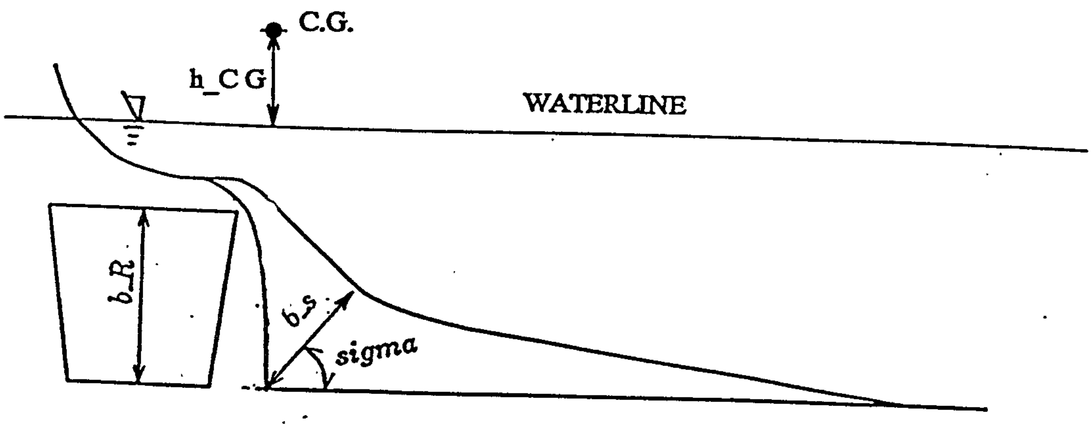

Figure 7: Skeg and Rudder Parameters

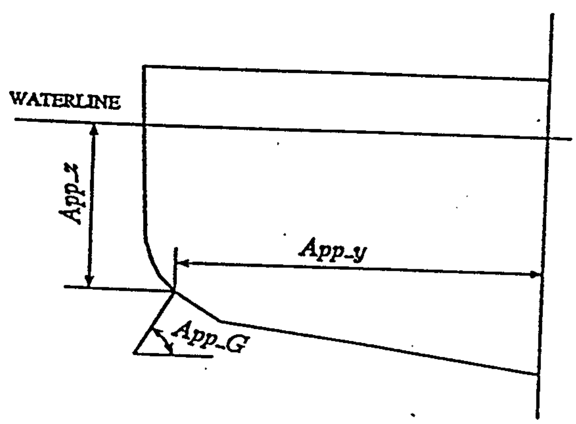

Figure 8: Appendage Parameters

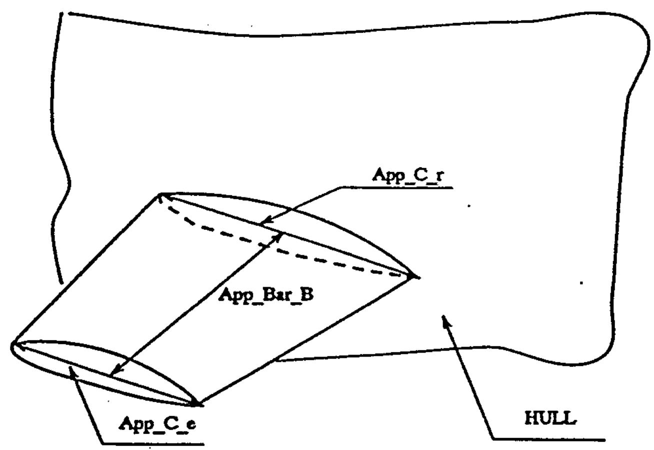

Figure 9: Appendage Parameter Example

The following is an example of the data file **vdamp_a.in** for AOR, $L = 162.46m$:

Record (a)	: 1	1	1	0	1
Record (b)	: 21	9	14		
Record (c)	: 999.099976	1.14E-06			
Record (d)	: 0.4	.0098			
Record (e1,1)	: 2	73.189	10.4	5.9	6.7
Record (e1,2)	: 2	151.752	12.9	8.2	7.2
Record (e1,3)	: 2	170.721	16.7	8.344	9.144
Record (..)	: ..	....	....	....	....
Record (..)	: ..	....	....	....	....
Record (e1,20)	: 2	123.93	3.9	8.344	9.144
Record (e1,21)	: 2	34.52	1.8	8.344	9.144
Record (e2,1)	: 5.9	63.	0.	0.65	4.0615
Record (e2,2)	: 8.2	49.	0.	3.05	8.123
Record (e2,3)	: 8.344	33.	0.	2.80	8.123
Record (..)	: ..	....	....	....	....
Record (..)	: ..	....	....	....	....
Record (e2,20)	: 8.344	10.	0.	1.0	8.123
Record (e2,21)	: 3.5	10.	0.	1.0	4.0615
Record (e3,1)	: 0.	0.	1.0	0.	
Record (e3,2)	: 0.	0.	0.9	0.	
Record (e3,3)	: 0.	0.	0.5	0.	

Record (..)	:	..	....	....	....	
Record (..)	:	..	....	....	....	
Record (..)	:	0.645	8.	0.4	0.	
Record (..)	:	0.645	8.3	0.4	0.	
Record (..)	:	..	....	....	....	
Record (..)	:	..	....	....	....	
Record (e3,20)	:	0.	0.	0.	0.	
Record (e3,21)	:	0.	0.	0.	0.	
Record (f)	:	0.	-0.8	7.315	0.	29.728
Record (g1)	:	0	0.			

The following is an example of the data file **vdamp_b.in** for MCDV, $L = 52.00m$:

Record (a)	:	1	1	1	0	1
Record (b)	:	21	9	14		
Record (c)	:	999.099976	1.14E-06			
Record (d)	:	0.35	.0269			
Record (e1,1)	:	3	12.402	9.4	1.81	0.8
Record (e1,2)	:	2	26.78	9.8	2.11	1.1
Record (e1,3)	:	2	28.236	10.	2.3	1.29
Record (..)	:	..	....	....	....	....
Record (..)	:	..	....	....	....	....
Record (e1,20)	:	2	18.92	2.48	4.41	3.4
Record (e1,21)	:	3	1.3	0.52	1.42	0.41
Record (e2,1)	:	1.81	34.	0.	0.36	1.3
Record (e2,2)	:	2.11	37.	0.	0.84	2.6
Record (e2,3)	:	2.3	4.	0.	0.8	2.6
Record (..)	:	..	....	....	....	....
Record (..)	:	..	....	....	....	....
Record (e2,20)	:	4.41	30.	0.	0.1	2.6
Record (e2,21)	:	1.42	30.	0.	0.1	1.3
Record (e3,1)	:	0.	0.	0.65	0.	
Record (e3,2)	:	0.	0.	0.65	0.	
Record (e3,3)	:	0.	0.	0.65	0.	
Record (..)	:	..	....	....	....	
Record (..)	:	..	....	....	....	
Record (..)	:	0.454	2.68	0.5	0.	
Record (..)	:	0.454	2.68	0.5	0.	
Record (..)	:	..	....	....	....	
Record (..)	:	..	....	....	....	
Record (e3,20)	:	0.	0.	0.	0.	

Record (e3,21)	: 0.	0.	0.	0.	
Record (f)	: 2.25	1.01	2.25	1.434	11.
Record (g1)	: 0	0.			

4.4 spectrum.in

The input data file **spectrum.in** provides the necessary data of spectral analysis for ship-a and ship-b. In **spectrum.in**, the data format is as following:

Record(a), Selection of sea spectrum

$NH31$ (1 integer)

$NH31$:

1. ISSC two parameter spectrum;
2. JONSWAP spectrum;
3. Bretschneider spectrum;

Record(b), Wave height and period

HA, $T1$ (2 real)

HA : significant wave hight (m)
$T1$: period corresponding to the average wave frequency of a spectrum (s)

As an example, the data file **spectrum.in** is as follows :

Record (a) :	3	
Record (b) :	3.7	8.123

5 Output Data File Description

The output file **shipint.out** contains ship principal dimensions, computation conditions, wave exciting forces, motion displacements and results from spectral analysis. The output data are as follows:

1. Non-dimensional wave exciting forces $\bar{f}_j$ and their phase angles $(pf)_j(degrees)$:

$$\bar{f}_j = |f_j|/\rho g \zeta_a LB, \quad (j = 1,\ 2,\ 3)$$
$$\bar{f}_j = |f_j|/\rho g \zeta_a L^2 B, \quad (j = 4,\ 5,\ 6)$$
$$(pf)_j = tan^{-1}[-\frac{Im(f_j)}{Re(f_j)}], \quad (j = 1, 2, ..., 6)$$

2. Non-dimensional ship motion displacements $\bar{x}_j$ and their phase angles $(pm)_j(degrees)$:

$$\bar{x}_j = |x_j|/\zeta_a \quad (j = 1,\ 2,\ 3)$$
$$\bar{x}_j = |x_j|/\zeta_a k \quad (j = 4,\ 5,\ 6)$$
$$(pm)_j = tan^{-1}[-\frac{Im(x_j)}{Re(x_j)}], \quad (j = 1, 2, ..., 6)$$

where

L :	ship length between perpendiculars (m)
B :	ship beam (m)
ρ :	water density (kg/m^3)
g :	gravitational acceleration (m/s^2)
ζ_a :	incident wave amplitude (m)
$k = \omega^2/g$:	wave number

and for ship-a,
$L = sla, \quad B = sba, \quad V = vola, \quad \bar{x}_j = \bar{x}_j^a$

for ship-b,
$L = slb, \quad B = sbb, \quad V = volb, \quad \bar{x}_j = \bar{x}_j^b$

3. Spectral Analysis – RMS displacements and accelerations:

$$D_j = \sqrt{(m_0)_j}$$
$$A_j = \sqrt{(m_0'')_j}$$

where, $(m_0)_j = \int_0^\infty [S_\eta(\omega_e)]_j d\omega_e$ and $(m_0'')_j = \int_0^\infty \omega_e^4 [S_\eta(\omega_e)]_j d\omega_e$.

The output file format is:

Record (a), Title of the Output File

```
************************
SHIPINT Program Output
************************
```

Record (b), General Specifications from Input

Date of Computation:	*date*	(alphanumeric characters)
Form of ship-a :	*namea*	(alphanumeric characters)
panel file :	*filea*	(alphanumeric characters)
ship-a particulars :	$sla, sba, sta, vola, cba$	(5 real numbers)
	xga, yga, zga	(3 real numbers)
	$ri44a, ri55a, ri66a$	(3 real numbers)
Form of ship-b :	*nameb*	(alphanumeric characters)
panel file :	*fileb*	(alphanumeric characters)
ship-b particulars :	$slb, sbb, stb, volb, cbb$	(5 real numbers)
	xgb, ygb, zgb	(3 real numbers)
	$ri44b, ri55b, ri66b$	(3 real numbers)

date :	user specified date of computation in **shipint.in**.
namea :	ship-a identification, alphanumeric characters with single-quotation marks, e.g. 'AOR'
filea :	the input data file of panel information for ship-a
sla :	ship-a length between perpendiculars (m)
sba :	ship-a beam (m)
sta :	ship-a draught (m)
vola :	volume displacement of the ship-a (m^3)
cba :	block coefficient of ship-a
xga :	x-coordinate of c.g. of ship relative to midships (m), in o_a-$x_a y_a z_a$ coordinate system.
yga :	y-coordinate of c.g. of ship relative to centerline (m) in o_a-$x_a y_a z_a$ coordinate system.

zga :	z-coordinate of c.g. of ship relative to calm waterline (m) in o_a-$x_a y_a z_a$ coordinate system.
$ri44a$:	roll radius of gyration of the ship-a (m), in o_a-$x_a y_a z_a$ coordinate system.
$ri55a$:	pitch radius of gyration of the ship-a (m), in o_a-$x_a y_a z_a$ coordinate system.
$ri66a$:	yaw radius of gyration of the ship-a (m), in o_a-$x_a y_a z_a$ coordinate system.

$nameb$:	ship-b identification, alphanumeric characters with single-quotation marks, e.g. 'MCDV'
$fileb$:	the input data file of panel information for ship-b
slb :	ship-b length between perpendiculars (m)
sbb :	ship-b beam (m)
stb :	ship-b draught (m)
$volb$:	volume displacement of the ship-b (m^3)
cbb :	block coefficient of ship-b
xgb :	x-coordinate of c.g. of ship relative to midships (m), in o_b-$x_b y_b z_b$ coordinate system.
ygb :	y-coordinate of c.g. of ship relative to centerline (m) in o_b-$x_b y_b z_b$ coordinate system.
zgb :	z-coordinate of c.g. of ship relative to calm waterline (m) in o_b-$x_b y_b z_b$ coordinate system.
$ri44b$:	roll radius of gyration of the ship-b (m), in o_b-$x_b y_b z_b$ coordinate system.
$ri55b$:	pitch radius of gyration of the ship-b (m), in o_b-$x_b y_b z_b$ coordinate system.
$ri66b$:	yaw radius of gyration of the ship-b (m), in o_b-$x_b y_b z_b$ coordinate system.

Record (c), Computation Condition

separation distance :	dy, dx	(2 real numbers)
ship speed :	U	(real numbers)

dy :	transverse separation distance (see Fig.1)
dx :	longitudinal separation distance (see Fig.1)

Record (d), Incident Wave Parameters

no	heading
1	wangle(1)
2	wangle(2)
...	
i	wangle(i)
...	
nangle	wangle(nangle)

no	Lambda/Lb
1	wslr(1)
2	wslr(2)
...	
i	wslr(i)
...	
nwl	wslr(nwl)

$nangle$: total number of incident wave headings
$wangle(i)$: wave heading angles in degrees, $i = 1, 2, ..., nangle$
nwl : total number of wave length to ship length ratios
$wslr(i)$: wave length to ship length ratios, $i = 1, 2, ..., nwl$

Record(e), Control Parameters

control parameters : $kdamp, kmterm$ (2 integers)

$kdamp$: if kdamp=1, the viscous damping coefficient computation is performed; if kdamp=0, the viscous damping coefficient computation is not performed.
$kmterm$: if kmterm=1, the double body m-term effect computation is performed; if kmterm=0, the simplified m-term effect computation is performed.

The following records (Record (f), (g) and (h)) are dependent of wave heading angle. There will be $nangle$ Record (f), (g) and (h) corresponding to each wave heading angle. We will only give the i^{th} records below.

Record (f1),Wave Exciting Force on Ship-a

Non-dimensional Wave exciting forces for ship-a: (Heading = $wangle(i)$)

no.	$Lambda/Lb$	$\bar{f}_1$	$\bar{f}_2$	$\bar{f}_3$	$\bar{f}_4$	$\bar{f}_5$	$\bar{f}_6$
1	$wslr(1)$	$\bar{f}_1(1)$	$\bar{f}_2(1)$	$\bar{f}_3(1)$	$\bar{f}_4(1)$	$\bar{f}_5(1)$	$\bar{f}_6(1)$
2	$wslr(2)$	$\bar{f}_1(2)$	$\bar{f}_2(2)$	$\bar{f}_3(2)$	$\bar{f}_4(2)$	$\bar{f}_5(2)$	$\bar{f}_6(2)$
...							
i	$wslr(i)$	$\bar{f}_1(i)$	$\bar{f}_2(i)$	$\bar{f}_3(i)$	$\bar{f}_4(i)$	$\bar{f}_5(i)$	$\bar{f}_6(i)$
...							
nwl	$wslr(nwl)$	$\bar{f}_1(nwl)$	$\bar{f}_2(nwl)$	$\bar{f}_3(nwl)$	$\bar{f}_4(nwl)$	$\bar{f}_5(nwl)$	$\bar{f}_6(nwl)$

Record (f2),Phase Angles of Wave Exciting Force on Ship-a

no.	$Lambda/Lb$	pf1	pf2	pf3	pf4	pf5	pf6
1	$wslr(1)$	pf1(1)	pf2(1)	pf3(1)	pf4(1)	pf5(1)	pf6(1)
2	$wslr(2)$	pf1(2)	pf2(2)	pf3(2)	pf4(2)	pf5(2)	pf6(2)
...							
i	$wslr(i)$	pf1(i)	pf2(i)	pf3(i)	pf4(i)	pf5(i)	pf6(i)
...							
nwl	$wslr(nwl)$	pf1(nwl)	pf2(nwl)	pf3(nwl)	pf4(nwl)	pf5(nwl)	pf6(nwl)

Record (g1),Wave Exciting Force on Ship-b

Non-dimensional Wave exciting forces for ship-b: (Heading = $wangle(i)$)

no.	$Lambda/Lb$	$\bar{f}_1$	$\bar{f}_2$	$\bar{f}_3$	$\bar{f}_4$	$\bar{f}_5$	$\bar{f}_6$
1	$wslr(1)$	$\bar{f}_1(1)$	$\bar{f}_2(1)$	$\bar{f}_3(1)$	$\bar{f}_4(1)$	$\bar{f}_5(1)$	$\bar{f}_6(1)$
2	$wslr(2)$	$\bar{f}_1(2)$	$\bar{f}_2(2)$	$\bar{f}_3(2)$	$\bar{f}_4(2)$	$\bar{f}_5(2)$	$\bar{f}_6(2)$
...							
i	$wslr(i)$	$\bar{f}_1(i)$	$\bar{f}_2(i)$	$\bar{f}_3(i)$	$\bar{f}_4(i)$	$\bar{f}_5(i)$	$\bar{f}_6(i)$
...							
nwl	$wslr(nwl)$	$\bar{f}_1(nwl)$	$\bar{f}_2(nwl)$	$\bar{f}_3(nwl)$	$\bar{f}_4(nwl)$	$\bar{f}_5(nwl)$	$\bar{f}_6(nwl)$

Record (g2),Phase Angles of Wave Exciting Force on Ship-b

no.	$Lambda/Lb$	pf1	pf2	pf3	pf4	pf5	pf6
1	$wslr(1)$	pf1(1)	pf2(1)	pf3(1)	pf4(1)	pf5(1)	pf6(1)

2	$wslr(2)$	pf1(2)	pf2(2)	pf3(2)	pf4(2)	pf5(2)	pf6(2)
...							
i	$wslr(i)$	pf1(i)	pf2(i)	pf3(i)	pf4(i)	pf5(i)	pf6(i)
...							
nwl	$wslr(nwl)$	pf1(nwl)	pf2(nwl)	pf3(nwl)	pf4(nwl)	pf5(nwl)	pf6(nwl)

Record (h1),Motion Displacement Amplitudes of Ship-a

Non-dimensional transfer function: motion displacement amplitude of ship-a:
Heading = $wangle(i)$

no.	$Lambda/Lb$	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$	$\bar{x}_5$	$\bar{x}_6$
1	$wslr(1)$	$\bar{x}_1(1)$	$\bar{x}_2(1)$	$\bar{x}_3(1)$	$\bar{x}_4(1)$	$\bar{x}_5(1)$	$\bar{x}_6(1)$
2	$wslr(2)$	$\bar{x}_1(2)$	$\bar{x}_2(2)$	$\bar{x}_3(2)$	$\bar{x}_4(2)$	$\bar{x}_5(2)$	$\bar{x}_6(2)$
...							
i	$wslr(i)$	$\bar{x}_1(i)$	$\bar{x}_2(i)$	$\bar{x}_3(i)$	$\bar{x}_4(i)$	$\bar{x}_5(i)$	$\bar{x}_6(i)$
...							
nwl	$wslr(nwl)$	$\bar{x}_1(nwl)$	$\bar{x}_2(nwl)$	$\bar{x}_3(nwl)$	$\bar{x}_4(nwl)$	$\bar{x}_5(nwl)$	$\bar{x}_6(nwl)$

Record (h2),Phase Angles of Motion Displacement Amplitudes of Ship-a

no.	$Lambda/Lb$	pm1	pm2	pm3	pm4	pm5	pm6
1	$wslr(1)$	pm1(1)	pm2(1)	pm3(1)	pm4(1)	pm5(1)	pm6(1)
2	$wslr(2)$	pm1(2)	pm2(2)	pm3(2)	pm4(2)	pm5(2)	pm6(2)
...							
i	$wslr(i)$	pm1(i)	pf2(i)	pf3(i)	pf4(i)	pf5(i)	pm6(i)
...							
nwl	$wslr(nwl)$	pm1(nwl)	pm2(nwl)	pm3(nwl)	pm4(nwl)	pm5(nwl)	pm6(nwl)

Record (i1),Motion Displacement Amplitudes of Ship-b

Non-dimensional transfer function: motion displacement amplitude of ship-b:
Heading = $wangle(i)$

no.	$Lambda/Lb$	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$	$\bar{x}_5$	$\bar{x}_6$
1	$wslr(1)$	$\bar{x}_1(1)$	$\bar{x}_2(1)$	$\bar{x}_3(1)$	$\bar{x}_4(1)$	$\bar{x}_5(1)$	$\bar{x}_6(1)$
2	$wslr(2)$	$\bar{x}_1(2)$	$\bar{x}_2(2)$	$\bar{x}_3(2)$	$\bar{x}_4(2)$	$\bar{x}_5(2)$	$\bar{x}_6(2)$
...							
i	$wslr(i)$	$\bar{x}_1(i)$	$\bar{x}_2(i)$	$\bar{x}_3(i)$	$\bar{x}_4(i)$	$\bar{x}_5(i)$	$\bar{x}_6(i)$
...							
nwl	$wslr(nwl)$	$\bar{x}_1(nwl)$	$\bar{x}_2(nwl)$	$\bar{x}_3(nwl)$	$\bar{x}_4(nwl)$	$\bar{x}_5(nwl)$	$\bar{x}_6(nwl)$

Record (i2),Phase Angles of Motion Displacement Amplitudes of Ship-b

no.	*Lambda/Lb*	pm1	pm2	pm3	pm4	pm5	pm6
1	$wslr(1)$	pm1(1)	pm2(1)	pm3(1)	pm4(1)	pm5(1)	pm6(1)
2	$wslr(2)$	pm1(2)	pm2(2)	pm3(2)	pm4(2)	pm5(2)	pm6(2)
...							
i	$wslr(i)$	pm1(i)	pf2(i)	pf3(i)	pf4(i)	pf5(i)	pm6(i)
...							
nwl	$wslr(nwl)$	pm1(nwl)	pm2(nwl)	pm3(nwl)	pm4(nwl)	pm5(nwl)	pm6(nwl)

Record (j), Spectral Analysis of Ship-a

Spectral analysis for ship-a (Heading = $wangle(i)$) :
RMS displacements and accelerations, T1=8.123sec

motion mode	RMS displacement	RMS acceleration
1	D_1	A_1
2	D_2	A_2
3	D_3	A_3
4	D_4	A_4
5	D_5	A_5
6	D_6	A_6

Record (k), Spectral Analysis of Ship-b

Spectral analysis for ship-b (Heading = wangle(i)) :
RMS displacements and accelerations, T1=8.123sec

motion mode	RMS displacement	RMS acceleration
1	D_1	A_1
2	D_2	A_2
3	D_3	A_3
4	D_4	A_4
5	D_5	A_5
6	D_6	A_6

D_j : RMS displacements in j^{th} mode of motion
the unit is m for j = 1, 2, 3, and

	the unit is *degree* for j = 4, 5, 6.
A_j :	RMS acceleration in j^{th} mode of motion the unit is g ($g = 9.81 m/sec^2$) for j = 1, 2, 3, and the unit is $degree/second^2$ for j = 4, 5, 6.

References

[1] Hsiung,C.C. and He,Y.J., "Final Report on Frequency-Domain Analysis of Interaction Effects Between Two Ships in Waves Using the 3-D Panel Method", DREA Contract Report, Technical Report CMVDR-96-3, 20 June, 1996.

[2] Hsiung,C.C., He,Y.J. and Lu, X.G., "User's Guide for PANELGEN - a Program for Generating Hull Panels", DREA Contractor Report 96/419, 1996.

[3] Hsiung, C.C. and Huang, Z.J., "Final Report - The Frequency-Domain Prediction of Added Resistance of Ships in Waves Using a Near-Field, 3-Dimensional Flow Method", DREA Contractor Report 95/484, 1995.

[4] Hsiung, C.C. and Huang, Z.J., "User's Guide for SMCA4, a Computer Program for Ship Motion, Sea Loads and Added Wave Resistance Prediction", DREA Contractor Report 95/485, 1995.

[5] Schmitke, R.T., "Ship Sway, Roll, and Yaw Motions in Oblique Seas", SNAME Transactions, Vol. 86, pp. 24-46, 1978.

Appendix A. Input File Examples

- **shipint.in**
- **panel_a.in**
- **panel_b.in**
- **vdamp_a.in**
- **vdamp_b.in**
- **spectrum.in**

```
'July 20, 1996'
'AOR' 'panel_a.in'
162.46  23.16  9.144  20833.82  0.6
0.0  0.0  -0.8
9.032  40.615  40.615
'MCDV' 'panel_b.in'
52.  10.76  3.4  1065.89  0.5603
-0.86  0.0   1.01
3.67  14.56 14.56
25.44 0.0
5.144
7
45.
90.
135.
180.
225.
270.
315.
15
0.2
0.6
1.0
1.4
1.8
2.2
2.6
3.0
3.4
3.8
4.2
4.6
5.0
5.4
5.8
1 1
```

```
252 200
1 81.250000 0.000000 0.000000
2 73.125000 -1.951219 0.000000
3 65.000000 -3.812500 0.000000
4 56.875000 -5.618902 0.000000
5 48.750000 -7.263720 0.000000
6 40.625000 -8.658536 0.000000
7 32.500000 -9.725610 0.000000
8 24.375000 -10.487805 0.000000
9 16.250000 -11.036586 0.000000
10 8.125000 -11.365854 0.000000
11 0.000000 -11.539634 0.000000
12 -8.125000 -11.585366 0.000000
13 -16.250000 -11.579268 0.000000
14 -24.375000 -11.496951 0.000000
15 -32.500000 -11.228659 0.000000
16 -40.625000 -10.649390 0.000000
17 -48.750000 -9.716464 0.000000
18 -56.875000 -8.353658 0.000000
19 -65.000000 -6.463415 0.000000
20 -70.687500 -5.182927 0.000000
21 -81.463425 0.000000 0.000000
22 80.640244 0.000000 -1.829268
23 73.125000 -1.692073 -2.286585
24 65.000000 -3.509909 -2.286585
25 56.875000 -5.254573 -2.286585
26 48.750000 -6.932165 -2.286585
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2     194.748   19.5     8.344   9.144
2     211.188   21.3     8.344   9.144
2     224.471   22.5     8.344   9.144
2     237.11    23.1     8.344   9.144
2     242.17    23.2     8.344   9.144
2     245.33    23.2     8.344   9.144
2     245.33    23.2     8.344   9.144
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2     225.      21.      8.344   9.144
2     212.45    19.4     8.344   9.144
2     196.01    17.3     8.344   9.144
2     179.57    14.6     8.344   9.144
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 2   26.78   9.8     2.11   1.1
 2   28.236  10.     2.3    1.29
 2   31.044  10.28   2.72   1.71
 2   33.8    10.44   3.22   2.21
 2   35.984  10.6    3.72   2.71
 2   37.96   10.7    4.04   3.03
 2   39.104  10.72   4.22   3.21
 2   40.092  10.76   4.41   3.4
 2   41.808  10.64   4.41   3.4
 2   39.728  10.64   4.41   3.4
 2   38.168  10.30   4.41   3.4
 2   37.024  10.04   4.41   3.4
 2   35.36   9.6     4.41   3.4
 2   32.76   8.96    4.41   3.4
 2   29.848  8.      4.41   3.4
 2   27.404  7.12    4.41   3.4
 2   24.44   5.84    4.41   3.4
 2   21.632  4.24    4.41   3.4
 2   18.92   2.48    4.41   3.4
 3   1.3     0.52    1.42   0.41
1.81  34.  0.  0.36     1.3
2.11  37.  0.  0.84     2.6
2.3   4.   0.  0.8      2.6
2.72  5.   0.  0.6      2.6
3.22  5.   0.  0.65     2.6
3.72  5.   0.  0.65     2.6
4.04  5.   0.  0.       2.6
4.22  5.   0.  0.96     2.6
4.41  5.   0.  1.06     2.6
4.41  7.   5.95   1.1   2.6
4.41  7.   5.95   1.1   2.6
4.41  9.   5.75   1.07  2.6
4.41  10.  5.555  1.0   2.6
4.41  12.  5.25   1.26  2.6
4.41  15.  4.85   1.75  2.6
4.41  18.  0.     1.75  2.6
4.41  23.  0.     1.84  2.6
4.41  26.  0.     1.84  2.6
4.41  28.  0.     0.1   2.6
4.41  30.  0.     0.1   2.6
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0.     0.   0.65  0.
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0.     0.   0.65  0.
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0.     0.   0.65  0.
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0.     0.   1.4   0.
0.     0.   0.    0.
0.     0.   0.    0.
0.     0.   0.    0.
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      0.      0.    0.     0.
   2.25   1.01     2.25    1.434     11.
    0  0.
```

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3
3.7  8.123
```

Appendix B. Output File Examples

- **shipint.out**

```
***************************************
 SHIPINT Program Output Results
***************************************
Date of Computation:
July 20, 1996

Form of ship_a:
AOR
panel file : panel_a.in
Ship_a geometrical principals:
L=  162.46(m.) B=  23.16(m.) T=  9.14(m.) Vol=  20833.82(m.^3) Cb=  .60
Xg=   .00(m.)Yg=   .00(m.)Zg=  -.80(m.)
ri44=   9.03(m.) ri55=   40.62(m.) ri66=   40.62(m.)

Form of ship_b:
MCDV
panel file : panel_b.in
Ship_b geometrical principals:
L=   52.00(m.) B=  10.76(m.) T=  3.40(m.) Vol=   1065.89(m.^3) Cb=  .56
Xg=  -.86(m.)Yg=   .00(m.)Zg=  1.01(m.)
ri44=   3.67(m.) ri55=   14.56(m.) ri66=   14.56(m.)

separation distance: Dy= 25.44(m.)   Dx=   .00(m.)

ship speed:   5.144(m/s)

number of wave heading angles:  7
no. heading(Deg.)
1  45.
2  90.
3  135.
4  180.
5  225.
6  270.
7  315.

number of wave length to ship length ratios:  15
no. Lambda/L
 1     .20
 2     .60
 3    1.00
 4    1.40
 5    1.80
 6    2.20
 7    2.60
 8    3.00
 9    3.40
10    3.80
11    4.20
12    4.60
13    5.00
14    5.40
15    5.80

control parameters for viscous damping and m-term:  1  1


nondimensional wave exciting forces on ship_a (Heading =  45.0 (Deg.)
--------------------------------------------------------------------

no. Lamda/Lb      f1       f2       f3       f4       f5       f6

 1    .20000    .00180   .00205   .00845   .00006   .00160   .00192
 2    .60000    .00979   .01629   .01846   .00022   .00689   .00618
 3   1.00000    .00894   .05487   .08011   .00097   .01339   .02382
```

4	1.40000	.02682	.08453	.02091	.00032	.02632	.00479
5	1.80000	.02558	.01516	.08754	.00055	.03023	.03283
6	2.20000	.03345	.05316	.13234	.00087	.03730	.04311
7	2.60000	.04340	.09718	.16918	.00094	.04534	.04405
8	3.00000	.05029	.12183	.20381	.00090	.05137	.04148
9	3.40000	.05425	.13397	.23634	.00084	.05515	.03790
10	3.80000	.05612	.13861	.26632	.00077	.05716	.03428
11	4.20000	.05661	.13889	.29362	.00070	.05793	.03097
12	4.60000	.05622	.13669	.31835	.00063	.05784	.02804
13	5.00000	.05527	.13313	.34072	.00058	.05720	.02551
14	5.40000	.05399	.12889	.36096	.00053	.05620	.02331
15	5.80000	.05252	.12436	.37932	.00049	.05498	.02142

phase angle (Deg.)of wave exciting forces on ship_a

no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	100.963	-71.781	106.932	-73.288	81.375	-75.599
2	.600	-87.758	-119.204	-150.214	-46.105	-97.200	10.266
3	1.000	4.182	-163.447	-26.185	139.300	-6.589	135.505
4	1.400	-121.433	-129.335	-160.087	178.217	-126.909	8.536
5	1.800	-175.372	-130.075	122.041	-34.007	-179.887	-13.762
6	2.200	141.139	70.357	94.783	-20.971	142.785	-11.721
7	2.600	121.707	72.350	74.895	-14.575	122.189	-10.008
8	3.000	112.127	74.493	60.506	-10.224	110.383	-8.756
9	3.400	106.579	76.212	50.048	-6.950	102.879	-7.825
10	3.800	103.021	77.557	42.272	-4.356	97.680	-7.109
11	4.200	100.586	78.612	36.332	-2.232	93.830	-6.541
12	4.600	98.844	79.447	31.679	-.451	90.823	-6.078
13	5.000	97.554	80.116	27.955	1.069	88.371	-5.693
14	5.400	96.573	80.656	24.917	2.383	86.297	-5.368
15	5.800	95.811	81.097	22.399	3.533	84.489	-5.088

nondimensional wave exciting forces on ship_b (Heading = 45.0 (Deg.)

no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.00538	.00318	.00876	.00099	.00585	.00121
2	.60000	.00563	.03150	.11895	.00218	.01417	.02107
3	1.00000	.04352	.07906	.15687	.00260	.07298	.02480
4	1.40000	.04384	.06986	.16834	.00186	.06853	.01716
5	1.80000	.03529	.05596	.17561	.00138	.05593	.01233
6	2.20000	.02951	.04876	.20386	.00113	.04889	.00993
7	2.60000	.02594	.04487	.24820	.00098	.04506	.00863
8	3.00000	.02351	.04219	.29453	.00088	.04259	.00780
9	3.40000	.02168	.03994	.33689	.00080	.04072	.00721
10	3.80000	.02019	.03790	.37396	.00074	.03919	.00676
11	4.20000	.01893	.03600	.40599	.00068	.03787	.00638
12	4.60000	.01782	.03424	.43367	.00064	.03674	.00607
13	5.00000	.01685	.03260	.45769	.00060	.03575	.00580
14	5.40000	.01599	.03107	.47869	.00056	.03490	.00556
15	5.80000	.01522	.02967	.49717	.00053	.03416	.00535

phase angle (Deg.)of wave exciting forces on ship_b

no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	51.437	101.115	26.923	-137.514	45.591	-146.460
2	.600	124.261	-124.023	-2.897	-149.866	18.899	145.289
3	1.000	-38.420	-37.615	-57.012	-138.823	-33.604	-132.779

4	1.400	-19.077	-4.966	-90.755	-117.670	-24.648	-96.078
5	1.800	1.078	19.641	-77.705	-98.886	-9.374	-69.814
6	2.200	19.328	38.750	-57.506	-84.711	3.946	-50.118
7	2.600	34.088	52.533	-43.209	-74.620	13.127	-35.856
8	3.000	45.633	62.354	-34.279	-67.306	18.901	-25.534
9	3.400	54.756	69.516	-28.469	-61.780	22.373	-17.892
10	3.800	62.158	74.905	-24.441	-57.426	24.350	-12.073
11	4.200	68.340	79.082	-21.494	-53.870	25.349	-7.522
12	4.600	73.641	82.403	-19.245	-50.880	25.696	-3.879
13	5.000	78.287	85.101	-17.470	-48.306	25.602	-.903
14	5.400	82.437	87.333	-16.032	-46.049	25.209	1.568
15	5.800	86.198	89.207	-14.843	-44.038	24.613	3.651

nondimensional transfer function: motion dispt. amplitudes on ship_a

Heading = 45.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.04971	.03286	.01214	.00822	.00038	.00438
2	.600	.04497	.01843	.08162	.00573	.01821	.00609
3	1.000	.05756	.05329	.11396	.03983	.04528	.02837
4	1.400	.18655	.12572	.17786	.02670	.14814	.01980
5	1.800	.22391	.02180	.26723	.03256	.18595	.11712
6	2.200	.31864	.13911	.30034	.08647	.24770	.19991
7	2.600	.43872	.26443	.36661	.12979	.33272	.26067
8	3.000	.54421	.36253	.45161	.16440	.41279	.30410
9	3.400	.62756	.43742	.53282	.19311	.47930	.33537
10	3.800	.69124	.49460	.60269	.21809	.53243	.35828
11	4.200	.73942	.53864	.66071	.24087	.57448	.37540
12	4.600	.77587	.57294	.70848	.26246	.60785	.38847
13	5.000	.80351	.59997	.74785	.28359	.63453	.39864
14	5.400	.82454	.62151	.78051	.30475	.65604	.40672
15	5.800	.84054	.63885	.80779	.32628	.67355	.41327

phase angle(Deg.) of motions of ship_a:

Heading = 45.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	-79.462	80.705	106.305	134.717	75.995	116.235
2	.600	51.904	30.824	143.997	131.504	-134.873	-160.775
3	1.000	112.797	86.590	-54.187	-37.487	-60.168	-19.400
4	1.400	22.032	81.758	75.331	-40.652	-156.969	167.427
5	1.800	-24.694	23.743	71.574	164.183	161.833	171.536
6	2.200	-58.966	-83.599	49.567	157.584	129.048	173.391
7	2.600	-74.615	-87.678	29.753	155.495	111.891	174.643
8	3.000	-81.913	-88.900	18.052	153.627	103.433	175.601
9	3.400	-85.760	-89.445	11.602	151.637	98.881	176.400
10	3.800	-88.012	-89.734	7.862	149.517	96.199	177.109
11	4.200	-89.446	-89.904	5.543	147.308	94.496	177.769
12	4.600	-90.424	-90.011	4.020	145.055	93.348	178.406
13	5.000	-91.133	-90.082	2.971	142.798	92.535	179.036
14	5.400	-91.675	-90.131	2.221	140.568	91.935	179.667
15	5.800	-92.107	-90.167	1.668	138.389	91.476	-179.693

nondimensional transfer function: motion dispt. amplitudes on ship_b

Heading = 45.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka

1	.200	.40259	.23117	.00933	.03643	.00279	.05011
2	.600	.15899	.15209	.29012	.69614	.04863	.18432
3	1.000	.93587	.54402	.45684	.64199	.39286	.28736
4	1.400	.73037	.49514	.35926	.54542	.37972	.24211
5	1.800	.68535	.54780	.39314	.57049	.40449	.26172
6	2.200	.76464	.62795	.54920	.57845	.48285	.28228
7	2.600	.84117	.68596	.67299	.56947	.55606	.29495
8	3.000	.89572	.72371	.76030	.55291	.61312	.30422
9	3.400	.93212	.74764	.82183	.53309	.65594	.31361
10	3.800	.95604	.76246	.86606	.51182	.68805	.32505
11	4.200	.97172	.77123	.89868	.48990	.71243	.33948
12	4.600	.98202	.77591	.92332	.46774	.73122	.35719
13	5.000	.98877	.77781	.94236	.44551	.74595	.37815
14	5.400	.99321	.77777	.95737	.42334	.75766	.40216
15	5.800	.99612	.77636	.96941	.40126	.76711	.42893

phase angle(Deg.) of motions of ship_b:

Heading = 45.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	-126.732	-89.314	20.584	-133.842	42.806	27.405
2	.600	-91.195	91.014	-20.538	-147.597	59.645	-34.579
3	1.000	122.381	133.293	-161.653	-146.383	-50.203	29.696
4	1.400	153.299	176.850	-129.845	-118.553	-22.561	74.816
5	1.800	-170.391	-149.240	-74.555	-103.726	10.400	100.904
6	2.200	-148.644	-133.293	-52.461	-98.731	29.702	111.172
7	2.600	-135.898	-125.175	-43.000	-96.971	40.801	114.728
8	3.000	-127.249	-120.247	-37.374	-96.282	48.132	115.146
9	3.400	-120.743	-116.832	-33.396	-95.958	53.475	113.933
10	3.800	-115.534	-114.251	-30.330	-95.762	57.609	111.878
11	4.200	-111.192	-112.189	-27.853	-95.611	60.931	109.466
12	4.600	-107.470	-110.481	-25.790	-95.480	63.674	107.005
13	5.000	-104.213	-109.031	-24.036	-95.364	65.982	104.688
14	5.400	-101.315	-107.776	-22.521	-95.265	67.956	102.619
15	5.800	-98.705	-106.676	-21.197	-95.186	69.665	100.846

RMS displacements and accelerations of ship-a
(Heading= 45.0(Deg.) average period T1=8.123(sec)

motion_mode j	Dj	Aj
1	.4325(m)	.0095(g)
2	.2954(m)	.0061(g)
3	.3875(m)	.0086(g)
4	.2807(deg)	.0699(deg/s^2)
5	.7281(deg)	.1857(deg/s^2)
6	.4970(deg)	.1215(deg/s^2)

RMS displacements and accelerations of ship-b
(Heading= 45.0(Deg.) average period T1=8.123(sec)

motion_mode j	Dj	Aj
1	.7573(m)	.0211(g)
2	.5855(m)	.0156(g)
3	.5970(m)	.0147(g)
4	2.7345(deg)	1.0576(deg/s^2)
5	1.4884(deg)	.4861(deg/s^2)
6	.9964(deg)	.3671(deg/s^2)

nondimensional wave exciting forces on ship_a (Heading = 90.0 (Deg.)

no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.00300	.03031	.02464	.00008	.00169	.00954
2	.60000	.00641	.26859	.13890	.00106	.00805	.02818
3	1.00000	.01136	.40935	.18018	.00186	.00540	.03133
4	1.40000	.01187	.45911	.26472	.00193	.00601	.02899
5	1.80000	.01108	.48033	.31575	.00187	.00619	.02444
6	2.20000	.01047	.46976	.35811	.00169	.00623	.02082
7	2.60000	.01101	.44367	.39634	.00148	.00560	.01796
8	3.00000	.01157	.41442	.42325	.00129	.00551	.01600
9	3.40000	.01175	.38450	.43987	.00113	.00630	.01471
10	3.80000	.01159	.35543	.44981	.00100	.00749	.01379
11	4.20000	.01121	.32831	.45617	.00089	.00871	.01306
12	4.60000	.01074	.30368	.46095	.00080	.00979	.01246
13	5.00000	.01023	.28164	.46523	.00073	.01072	.01193
14	5.40000	.00973	.26205	.46952	.00067	.01151	.01147
15	5.80000	.00925	.24468	.47400	.00061	.01217	.01105

phase angle (Deg.)of wave exciting forces on ship_a

no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	-29.143	21.860	2.448	98.655	-15.495	-175.120
2	.600	-149.494	107.092	112.061	91.012	89.015	18.591
3	1.000	-157.535	72.177	70.161	56.461	84.986	10.689
4	1.400	-158.681	67.347	50.707	54.638	60.592	15.787
5	1.800	-153.566	64.630	43.160	53.589	41.052	19.249
6	2.200	-155.595	66.779	36.359	56.199	34.115	20.771
7	2.600	-155.530	69.114	32.577	58.176	23.176	20.215
8	3.000	-151.255	71.454	30.519	59.429	5.946	18.334
9	3.400	-145.366	73.708	29.004	60.218	-8.451	16.337
10	3.800	-139.432	75.718	27.537	60.647	-16.197	14.715
11	4.200	-134.057	77.419	25.991	60.774	-19.574	13.486
12	4.600	-129.393	78.818	24.381	60.655	-20.791	12.544
13	5.000	-125.412	79.953	22.761	60.344	-21.009	11.793
14	5.400	-122.028	80.869	21.183	59.888	-20.779	11.167
15	5.800	-119.145	81.610	19.680	59.326	-20.359	10.626

nondimensional wave exciting forces on ship_b (Heading = 90.0 (Deg.)

no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.04137	.13746	.12641	.00182	.04856	.03568
2	.60000	.00165	.00579	.00858	.00012	.00163	.00223
3	1.00000	.00253	.01726	.02361	.00018	.00350	.00168
4	1.40000	.00636	.05506	.12716	.00026	.00236	.00305
5	1.80000	.00572	.02897	.08246	.00026	.00365	.00270
6	2.20000	.00808	.04577	.12746	.00043	.00702	.00415
7	2.60000	.00947	.05523	.19300	.00053	.01034	.00503
8	3.00000	.01009	.05844	.25067	.00059	.01330	.00553
9	3.40000	.01026	.05859	.29981	.00061	.01581	.00582
10	3.80000	.01020	.05724	.34171	.00061	.01786	.00597
11	4.20000	.01004	.05518	.37746	.00061	.01952	.00602
12	4.60000	.00984	.05282	.40802	.00060	.02087	.00602
13	5.00000	.00964	.05039	.43428	.00058	.02198	.00598
14	5.40000	.00945	.04802	.45698	.00057	.02291	.00592
15	5.80000	.00928	.04577	.47677	.00055	.02369	.00584

phase angle (Deg.)of wave exciting forces on ship_b

no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	-158.069	41.010	29.604	67.289	-148.727	34.761
2	.600	-100.849	-45.114	-7.065	25.286	-47.253	117.659
3	1.000	47.321	-134.700	-125.596	-120.580	3.571	-84.130
4	1.400	144.800	30.961	-15.719	-103.532	129.840	-42.907
5	1.800	141.256	18.789	-22.770	-134.499	-170.451	-64.061
6	2.200	150.073	15.126	-47.981	-128.161	-136.727	-58.199
7	2.600	162.599	27.299	-48.818	-115.022	-115.322	-47.310
8	3.000	172.821	37.971	-45.318	-103.939	-100.094	-38.454
9	3.400	-179.435	46.493	-41.509	-94.841	-88.413	-31.379
10	3.800	-173.703	53.336	-38.006	-87.273	-79.156	-25.620
11	4.200	-169.490	58.900	-34.897	-80.904	-71.684	-20.875
12	4.600	-166.390	63.479	-32.175	-75.487	-65.563	-16.929
13	5.000	-164.102	67.291	-29.802	-70.832	-60.481	-13.619
14	5.400	-162.406	70.501	-27.733	-66.791	-56.210	-10.820
15	5.800	-161.146	73.231	-25.927	-63.249	-52.578	-8.431

nondimensional transfer function: motion dispt. amplitudes on ship_a

Heading = 90.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.00098	.01394	.00283	.00010	.00005	.00029
2	.600	.00656	.20476	.08174	.00827	.00370	.00720
3	1.000	.02736	.38374	.32192	.02133	.00963	.01211
4	1.400	.06539	.53056	1.01728	.03487	.02877	.01271
5	1.800	.10279	.61148	1.56319	.03550	.09303	.01828
6	2.200	.09186	.63972	1.51960	.03739	.07497	.01669
7	2.600	.08624	.70147	1.30027	.03495	.08581	.01245
8	3.000	.09727	.75213	1.16785	.03014	.10938	.01269
9	3.400	.10937	.78907	1.10439	.02356	.12562	.01416
10	3.800	.11826	.81621	1.07652	.01660	.13478	.01602
11	4.200	.12382	.83663	1.06485	.01369	.13897	.01819
12	4.600	.12692	.85241	1.05979	.02019	.14010	.02066
13	5.000	.12840	.86491	1.05714	.03245	.13947	.02348
14	5.400	.12889	.87504	1.05525	.04735	.13790	.02668
15	5.800	.12882	.88338	1.05355	.06401	.13591	.03026

phase angle(Deg.) of motions of ship_a:

Heading = 90.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	144.575	179.893	-173.937	-113.976	-113.976	25.877
2	.600	50.082	-50.147	-61.725	-52.952	-100.471	-137.046
3	1.000	47.492	-74.838	-95.603	-80.417	-83.570	-121.518
4	1.400	76.482	-82.334	-80.959	-79.865	-95.199	-103.309
5	1.800	124.367	-82.900	-42.208	-80.454	-48.690	-101.293
6	2.200	158.560	-87.114	-16.988	-81.433	-13.492	-67.397
7	2.600	165.244	-90.042	-6.223	-78.889	-16.076	-69.588
8	3.000	171.389	-90.763	-3.477	-74.268	-5.612	-78.678
9	3.400	-179.712	-90.838	-3.147	-65.100	7.219	-83.996
10	3.800	-170.656	-90.728	-3.277	-44.748	18.807	-87.582
11	4.200	-162.590	-90.579	-3.319	-3.319	28.583	28.583
12	4.600	-155.785	-90.440	-3.208	39.426	36.655	-93.193
13	5.000	-150.177	-90.322	-3.002	57.352	43.283	-95.609
14	5.400	-145.604	-90.225	-2.756	65.785	48.738	-97.771
15	5.800	-141.892	-90.146	-2.505	70.515	53.248	-99.660

nondimensional transfer function: motion dispt. amplitudes on ship_b

Heading = 90.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.01530	.06053	.05869	.00929	.01288	.00624
2	.600	.02990	.17073	.24121	.04494	.05517	.01300
3	1.000	.01692	.27286	.38071	.20352	.03087	.02275
4	1.400	.12199	.11396	.15418	.42003	.18414	.01330
5	1.800	.24156	.30488	.26989	1.85821	.34617	.09743
6	2.200	.21429	.63276	.74791	1.80091	.33447	.12805
7	2.600	.17126	.75469	.92654	1.44344	.27851	.13592
8	3.000	.16500	.79998	.98593	1.22100	.25779	.14830
9	3.400	.17415	.82686	1.01911	1.08604	.25094	.16392
10	3.800	.18810	.84653	1.04080	.99387	.24751	.18122
11	4.200	.20295	.86152	1.05463	.92404	.24459	.19957
12	4.600	.21743	.87282	1.06293	.86702	.24171	.21877
13	5.000	.23128	.88115	1.06755	.81806	.23897	.23873
14	5.400	.24452	.88714	1.06982	.77454	.23653	.25940
15	5.800	.25727	.89130	1.07067	.73494	.23448	.28078

phase angle(Deg.) of motions of ship_b:

Heading = 90.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	52.794	-106.883	-146.472	-64.408	70.569	-98.691
2	.600	13.694	140.744	-166.449	-15.147	-144.552	-23.232
3	1.000	71.500	-135.603	-61.939	62.587	-61.971	-172.365
4	1.400	-146.744	-87.760	-36.785	-157.872	50.870	-98.482
5	1.800	-25.120	141.024	-145.001	53.864	168.487	-135.741
6	2.200	73.290	173.784	-116.538	136.744	-100.054	-66.865
7	2.600	132.645	-163.819	-89.255	172.778	-51.324	-35.733
8	3.000	170.649	-151.188	-73.913	-169.412	-22.893	-17.606
9	3.400	-162.144	-143.004	-63.738	-158.461	-2.756	-4.693
10	3.800	-141.632	-137.042	-56.147	-150.779	12.724	5.324
11	4.200	-125.713	-132.378	-50.154	-144.978	24.979	13.458
12	4.600	-113.094	-128.577	-45.292	-140.411	34.825	20.276
13	5.000	-102.907	-125.401	-41.279	-136.724	42.830	26.141
14	5.400	-94.546	-122.702	-37.920	-133.700	49.414	31.300
15	5.800	-87.578	-120.380	-35.074	-131.193	54.889	35.918

RMS displacements and accelerations of ship-a
(Heading= 90.0(Deg.) average period T1=8.123(sec)

motion_mode j	Dj	Aj
1	.0856(m)	.0041(g)
2	.6116(m)	.0319(g)
3	1.0614(m)	.0582(g)
4	.0962(deg)	.0854(deg/s^2)
5	.2094(deg)	.1120(deg/s^2)
6	.0482(deg)	.0521(deg/s^2)

RMS displacements and accelerations of ship-b
(Heading= 90.0(Deg.) average period T1=8.123(sec)

motion_mode j Dj Aj

1	.1633 (m)	.0085 (g)
2	.5861 (m)	.0261 (g)
3	.7137 (m)	.0323 (g)
4	3.4276 (deg)	2.1285 (deg/s^2)
5	.7245 (deg)	.7153 (deg/s^2)
6	.2877 (deg)	.1656 (deg/s^2)

nondimensional wave exciting forces on ship_a (Heading = 135.0 (Deg.)

no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.00094	.01082	.00323	.00006	.00148	.00578
2	.60000	.00771	.01807	.01884	.00037	.00582	.01273
3	1.00000	.01694	.02564	.01146	.00104	.00537	.02146
4	1.40000	.01394	.03814	.06566	.00015	.00766	.01855
5	1.80000	.02626	.13127	.03209	.00123	.02520	.04144
6	2.20000	.05359	.02663	.07165	.00082	.04773	.05678
7	2.60000	.06657	.07217	.12773	.00099	.06116	.06001
8	3.00000	.07263	.12368	.19296	.00105	.06731	.05740
9	3.40000	.07419	.15521	.24888	.00101	.06898	.05148
10	3.80000	.07318	.17331	.29460	.00093	.06830	.04394
11	4.20000	.07130	.18193	.33103	.00083	.06684	.03643
12	4.60000	.06932	.18399	.35955	.00074	.06526	.02984
13	5.00000	.06744	.18172	.38188	.00066	.06373	.02439
14	5.40000	.06564	.17681	.39962	.00060	.06228	.01999
15	5.80000	.06387	.17045	.41408	.00055	.06086	.01647

phase angle (Deg.)of wave exciting forces on ship_a

no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	-21.497	95.978	3.255	150.139	23.353	72.133
2	.600	133.921	-119.731	170.554	-99.666	161.799	-153.567
3	1.000	120.196	1.711	-27.315	26.209	98.753	-7.432
4	1.400	94.423	-166.715	-159.860	107.705	134.095	-158.539
5	1.800	-64.650	164.378	-85.510	169.971	-80.069	164.113
6	2.200	-71.828	-146.187	36.520	163.093	-78.686	155.495
7	2.600	-75.585	56.488	24.528	139.584	-77.002	155.212
8	3.000	-78.320	58.786	20.348	133.255	-76.066	157.237
9	3.400	-80.178	61.278	18.866	130.664	-75.541	160.968
10	3.800	-82.017	64.043	18.143	128.698	-75.672	164.862
11	4.200	-83.983	66.832	17.714	126.214	-76.259	167.950
12	4.600	-85.846	69.467	17.337	123.212	-76.951	169.998
13	5.000	-87.431	71.831	16.892	120.022	-77.526	171.128
14	5.400	-88.691	73.877	16.344	116.893	-77.903	171.546
15	5.800	-89.657	75.606	15.702	113.939	-78.076	171.432

nondimensional wave exciting forces on ship_b (Heading = 135.0 (Deg.)

no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.01538	.04752	.06193	.00069	.03388	.01302
2	.60000	.02331	.04947	.21237	.00223	.02583	.03013
3	1.00000	.04249	.07753	.04376	.00212	.05346	.04012
4	1.40000	.06174	.09620	.25019	.00288	.09085	.03629
5	1.80000	.03375	.28417	.56037	.00254	.05621	.01824
6	2.20000	.04804	.20808	.34766	.00070	.05719	.00479
7	2.60000	.03622	.10472	.30251	.00038	.04786	.00371
8	3.00000	.03180	.07372	.34594	.00031	.04184	.00381
9	3.40000	.03111	.05969	.37875	.00026	.04002	.00368

10	3.80000	.03132	.05175	.40303	.00023	.04033	.00338
11	4.20000	.03124	.04688	.42359	.00022	.04099	.00314
12	4.60000	.03074	.04361	.44239	.00023	.04135	.00303
13	5.00000	.02997	.04114	.45984	.00024	.04137	.00304
14	5.40000	.02908	.03908	.47594	.00025	.04117	.00309
15	5.80000	.02814	.03724	.49065	.00026	.04083	.00316

phase angle (Deg.)of wave exciting forces on ship_b

no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	162.898	-22.449	156.970	7.995	150.449	-18.103
2	.600	91.267	89.496	-4.126	-158.013	37.106	-49.090
3	1.000	-178.173	8.092	-115.847	59.173	164.146	80.270
4	1.400	-149.280	-6.887	-85.095	97.909	-147.843	103.937
5	1.800	-150.909	23.415	-38.531	-168.326	-117.898	-143.097
6	2.200	-131.171	96.633	4.101	-93.362	-111.019	49.770
7	2.600	-124.829	109.416	-11.890	-72.107	-101.320	65.114
8	3.000	-128.954	107.626	-15.010	-50.329	-99.866	59.016
9	3.400	-132.284	105.015	-14.285	-38.433	-100.438	57.643
10	3.800	-132.788	102.426	-13.420	-35.794	-99.434	54.416
11	4.200	-131.693	100.327	-12.820	-37.344	-96.698	48.685
12	4.600	-130.148	98.980	-12.367	-38.854	-93.169	42.290
13	5.000	-128.647	98.340	-11.954	-39.061	-89.478	36.846
14	5.400	-127.337	98.226	-11.543	-38.221	-85.899	32.838
15	5.800	-126.239	98.449	-11.131	-36.804	-82.530	30.073

nondimensional transfer function: motion dispt. amplitudes on ship_a

Heading = 135.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.00006	.00065	.00017	.00001	.00001	.00006
2	.600	.00252	.00362	.00658	.00117	.00079	.00202
3	1.000	.01248	.02040	.00598	.01222	.00349	.00900
4	1.400	.00895	.09277	.07711	.01204	.01470	.01640
5	1.800	.03752	.05239	.04360	.01594	.09832	.05378
6	2.200	.04802	.06988	.46615	.02099	.37696	.10296
7	2.600	.05484	.16696	1.31449	.04573	.77636	.16296
8	3.000	.13508	.26326	1.39094	.07303	1.01389	.18960
9	3.400	.23714	.32398	1.14201	.08786	1.04106	.20468
10	3.800	.30772	.35763	1.02967	.10116	1.01991	.22904
11	4.200	.36061	.38723	.96810	.11353	.99675	.24946
12	4.600	.39822	.41504	.93066	.12455	.96547	.26446
13	5.000	.42166	.43987	.91465	.13437	.92559	.27548
14	5.400	.43391	.46116	.91549	.14329	.88148	.28384
15	5.800	.43859	.47908	.92653	.15155	.83783	.29040

phase angle(Deg.) of motions of ship_a:

Heading = 135.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	146.813	-75.873	175.399	175.399	175.399	175.399
2	.600	-47.059	106.735	5.604	95.818	-12.752	36.858
3	1.000	-58.368	-101.197	120.921	-129.943	-91.422	-171.219
4	1.400	-93.541	86.782	22.245	135.077	-28.460	78.459
5	1.800	147.496	125.489	-35.798	72.990	119.590	13.625
6	2.200	137.760	-134.628	-102.740	33.210	148.062	3.290
7	2.600	83.746	-112.948	-56.431	-5.341	179.863	2.429

8	3.000	55.406	-102.806	-15.602	-1.675	-149.638	6.791
9	3.400	64.072	-94.617	-2.173	-.521	-129.272	3.234
10	3.800	72.358	-91.726	.781	-1.213	-117.374	.802
11	4.200	78.799	-91.118	1.425	-1.305	-108.901	.168
12	4.600	84.340	-90.934	.639	-.848	-102.180	.000
13	5.000	89.005	-90.723	-.860	.000	-96.881	-.272
14	5.400	92.710	-90.456	-2.370	1.023	-92.888	-.612
15	5.800	95.479	-90.177	-3.510	2.281	-90.046	-1.055

nondimensional transfer function: motion dispt. amplitudes on ship_b

Heading = 135.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.00177	.00943	.00510	.00089	.00210	.00105
2	.600	.02843	.06383	.19386	.05689	.04793	.03146
3	1.000	.00703	.06939	.62677	.11903	.42235	.10400
4	1.400	.15897	.44644	1.06791	.69338	.83187	.35677
5	1.800	.20027	.44355	.65476	1.03247	.68165	.27014
6	2.200	.34179	.36494	.30952	1.81208	.79650	.19740
7	2.600	.22223	.27522	.42868	.59705	.40487	.15023
8	3.000	.06574	.34876	1.07111	1.27188	.12535	.06712
9	3.400	.28514	.40356	1.10565	1.01104	.53978	.15680
10	3.800	.40220	.41941	1.00205	.86977	.71936	.21845
11	4.200	.44325	.43061	.94674	.79738	.76654	.25873
12	4.600	.44609	.43910	.93468	.74568	.75542	.28713
13	5.000	.42974	.44695	.94748	.70605	.71818	.30827
14	5.400	.40571	.45530	.97081	.67409	.67174	.32453
15	5.800	.38121	.46411	.99575	.64669	.62546	.33739

phase angle(Deg.) of motions of ship_b:

Heading = 135.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	-1.347	160.820	-19.691	-159.040	-34.685	165.973
2	.600	-47.163	-111.338	-160.472	21.915	-122.305	120.839
3	1.000	46.743	111.164	149.937	-122.198	47.823	-90.295
4	1.400	-4.549	-131.098	-65.528	-34.313	163.996	-46.076
5	1.800	10.062	-74.644	-28.761	23.177	-167.543	4.590
6	2.200	48.730	-41.051	-9.474	86.221	-125.637	27.339
7	2.600	103.452	50.242	-124.058	-161.131	-73.850	69.425
8	3.000	-111.584	158.124	-81.650	133.261	93.692	-130.011
9	3.400	-22.150	-157.396	-52.922	167.258	165.306	-75.838
10	3.800	8.363	-140.271	-41.979	178.733	-164.708	-55.813
11	4.200	26.763	-131.464	-38.334	-173.005	-145.718	-42.879
12	4.600	39.013	-126.148	-36.929	-166.511	-132.420	-33.229
13	5.000	47.139	-122.707	-35.840	-161.310	-122.850	-25.445
14	5.400	52.079	-120.288	-34.470	-156.996	-116.060	-18.878
15	5.800	54.479	-118.403	-32.794	-153.325	-111.422	-13.180

RMS displacements and accelerations of ship-a
(Heading= 135.0(Deg.) average period T1=8.123(sec)

motion_mode j	Dj	Aj
1	.1735(m)	.0077(g)
2	.2124(m)	.0112(g)
3	.7641(m)	.0456(g)
4	.1172(deg)	.1805(deg/s^2)
5	1.3215(deg)	.8006(deg/s^2)

6	.2982(deg)	.2105(deg/s^2)

RMS displacements and accelerations of ship-b
(Heading= 135.0(Deg.) average period T1=8.123(sec)

motion_mode j	Dj	Aj
1	.2475(m)	.0178(g)
2	.3338(m)	.0317(g)
3	.7224(m)	.0771(g)
4	2.7455(deg)	2.8466(deg/s^2)
5	2.0050(deg)	5.9208(deg/s^2)
6	.7085(deg)	1.2102(deg/s^2)

nondimensional wave exciting forces on ship_a (Heading = 180.0 (Deg.)

no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.00202	.00170	.00367	.00002	.00260	.00072
2	.60000	.00899	.04955	.02026	.00023	.00621	.00433
3	1.00000	.01541	.01014	.00883	.00008	.01032	.00391
4	1.40000	.02586	.01894	.07651	.00016	.02275	.00222
5	1.80000	.02412	.05863	.05194	.00036	.01313	.00427
6	2.20000	.00562	.15605	.01184	.00079	.01234	.00279
7	2.60000	.03473	.12280	.05669	.00045	.03858	.00239
8	3.00000	.05466	.08832	.06698	.00026	.05676	.00192
9	3.40000	.06713	.07283	.11320	.00019	.06760	.00214
10	3.80000	.07413	.06277	.16317	.00016	.07342	.00231
11	4.20000	.07743	.05454	.20846	.00013	.07606	.00227
12	4.60000	.07858	.04739	.24788	.00012	.07693	.00212
13	5.00000	.07860	.04121	.28157	.00010	.07687	.00194
14	5.40000	.07800	.03593	.31015	.00009	.07630	.00175
15	5.80000	.07705	.03147	.33443	.00008	.07544	.00159

phase angle (Deg.)of wave exciting forces on ship_a

no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	-29.340	-109.260	-46.346	170.099	-37.148	176.968
2	.600	-60.963	67.486	-92.628	114.020	-86.270	75.812
3	1.000	-73.654	144.456	-43.747	150.768	-91.684	-152.784
4	1.400	91.085	119.864	107.134	130.048	72.180	-136.640
5	1.800	100.999	149.257	-168.154	158.937	109.154	-59.178
6	2.200	-75.046	-154.609	71.823	-136.712	-101.506	22.965
7	2.600	-76.823	-94.509	91.281	-76.903	-89.935	111.189
8	3.000	-78.740	-73.414	51.735	-61.620	-84.661	147.378
9	3.400	-80.292	-60.837	30.277	-55.660	-82.350	169.602
10	3.800	-81.523	-50.113	23.006	-51.992	-81.180	-168.565
11	4.200	-82.759	-40.679	19.597	-47.955	-80.729	-150.323
12	4.600	-84.090	-32.583	17.618	-43.466	-80.725	-136.244
13	5.000	-85.420	-25.791	16.287	-39.158	-80.925	-125.705
14	5.400	-86.645	-20.198	15.267	-35.454	-81.163	-117.890
15	5.800	-87.708	-15.659	14.399	-32.492	-81.350	-112.101

nondimensional wave exciting forces on ship_b (Heading = 180.0 (Deg.)

no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.00655	.00391	.02385	.00035	.00428	.00300

2	.60000	.05093	.08427	.09548	.00118	.06398	.02807
3	1.00000	.04216	.02458	.03893	.00094	.05165	.00834
4	1.40000	.07285	.05345	.16975	.00109	.10188	.01068
5	1.80000	.08690	.12281	.38841	.00194	.12998	.02189
6	2.20000	.06587	.30842	.84986	.00177	.10094	.01430
7	2.60000	.08486	.20879	.65152	.00070	.10383	.00786
8	3.00000	.07522	.12199	.52784	.00037	.09789	.00493
9	3.40000	.06569	.08514	.51619	.00032	.08948	.00362
10	3.80000	.05757	.06578	.52919	.00031	.08077	.00316
11	4.20000	.05121	.05346	.54412	.00030	.07316	.00298
12	4.60000	.04645	.04477	.55628	.00029	.06703	.00288
13	5.00000	.04289	.03830	.56543	.00028	.06224	.00277
14	5.40000	.04015	.03333	.57227	.00026	.05849	.00267
15	5.80000	.03796	.02943	.57752	.00025	.05551	.00257

phase angle (Deg.)of wave exciting forces on ship_b

no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	-114.400	-91.598	102.796	103.769	152.605	-127.585
2	.600	105.751	-63.879	-123.737	-69.351	103.337	-77.686
3	1.000	-70.393	-131.851	-159.243	-81.757	-94.529	-56.219
4	1.400	-85.727	-63.227	-12.033	28.464	-90.230	58.935
5	1.800	-79.841	-23.741	-15.306	138.412	-78.271	156.810
6	2.200	-98.860	54.928	11.661	-106.608	-73.328	-56.264
7	2.600	-90.886	127.328	40.246	-22.636	-73.404	71.557
8	3.000	-84.952	152.045	35.017	-.465	-68.324	107.238
9	3.400	-83.190	162.105	28.255	6.526	-64.018	111.378
10	3.800	-83.397	168.006	24.181	14.357	-60.935	107.941
11	4.200	-84.921	172.158	21.770	21.949	-59.063	105.205
12	4.600	-87.086	175.161	20.169	28.233	-58.015	103.844
13	5.000	-89.388	177.311	18.950	33.169	-57.403	103.175
14	5.400	-91.556	178.827	17.915	37.000	-56.970	102.761
15	5.800	-93.489	179.882	16.973	39.986	-56.573	102.413

nondimensional transfer function: motion dispt. amplitudes on ship_a

Heading = 180.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.00009	.00006	.00010	.00000	.00002	.00000
2	.600	.00228	.01112	.00269	.00040	.00066	.00048
3	1.000	.00832	.00751	.00431	.00085	.00422	.00239
4	1.400	.01810	.06106	.08873	.01008	.02439	.00282
5	1.800	.02629	.02989	.12110	.00464	.03492	.00797
6	2.200	.02182	.02057	.14417	.00140	.07793	.00240
7	2.600	.02831	.02744	.21087	.00721	.37639	.00970
8	3.000	.01747	.04694	.90166	.00864	.82987	.01225
9	3.400	.12087	.06485	1.04174	.00428	1.14769	.01279
10	3.800	.22850	.06042	.88319	.00125	1.23214	.01517
11	4.200	.31028	.04493	.83550	.00298	1.25267	.01507
12	4.600	.37919	.03207	.81957	.00369	1.26612	.01381
13	5.000	.43548	.02424	.80713	.00390	1.26501	.01245
14	5.400	.47770	.02091	.80274	.00397	1.24673	.01145
15	5.800	.50689	.02038	.80974	.00404	1.21561	.01104

phase angle(Deg.) of motions of ship_a:

Heading = 180.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6

1	.200	151.952	68.829	129.566	129.566	129.566	129.566
2	.600	118.550	-68.755	106.721	-22.999	95.824	-58.048
3	1.000	108.617	-28.934	161.686	-18.469	91.607	58.122
4	1.400	-72.790	110.226	-62.187	109.660	-109.204	74.340
5	1.800	-86.389	-162.379	9.270	-112.996	-56.590	-121.363
6	2.200	-163.325	-155.493	27.005	75.315	111.102	-135.893
7	2.600	-176.396	-170.286	-89.570	-89.570	144.355	-107.022
8	3.000	31.321	-155.662	-47.704	-107.291	175.791	-18.688
9	3.400	34.839	-124.012	-8.485	-53.995	-154.901	98.393
10	3.800	52.855	-89.392	2.727	-114.199	-135.245	-177.549
11	4.200	63.390	-67.966	3.489	-128.668	-123.900	-134.885
12	4.600	70.530	-59.313	3.542	-120.444	-115.816	-112.365
13	5.000	76.401	-60.998	2.739	-115.978	-109.241	-100.977
14	5.400	81.378	-68.277	1.102	-115.223	-103.837	-96.820
15	5.800	85.461	-74.882	-.818	-117.058	-99.537	-97.027

nondimensional transfer function: motion dispt. amplitudes on ship_b

Heading = 180.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.00122	.00053	.00173	.00035	.00017	.00017
2	.600	.03299	.06768	.06042	.01438	.06478	.02465
3	1.000	.04257	.04492	.09807	.05904	.23269	.03798
4	1.400	.09085	.34266	1.92372	.04179	1.07096	.12011
5	1.800	.24685	.09332	1.12812	.30231	1.21537	.15902
6	2.200	.36659	.06231	1.03572	.59274	1.29030	.13972
7	2.600	.56061	.19496	.91839	2.06579	1.53930	.19128
8	3.000	.54862	.31817	.45482	2.37213	1.26215	.32329
9	3.400	.29025	.25587	.96974	1.17637	.57706	.31832
10	3.800	.08288	.13195	1.22552	.79070	.22576	.26241
11	4.200	.33287	.07071	1.15226	.44665	.69834	.20486
12	4.600	.47197	.04745	1.04814	.24587	.92954	.15694
13	5.000	.54428	.04180	.97418	.12799	1.03207	.11734
14	5.400	.57522	.04560	.93602	.05324	1.06252	.08376
15	5.800	.58085	.05223	.92671	.01975	1.05256	.05489

phase angle(Deg.) of motions of ship_b:

Heading = 180.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	76.014	91.735	-80.561	-78.966	-28.455	53.523
2	.600	-37.314	172.366	74.836	177.782	-47.963	154.399
3	1.000	169.533	50.185	-106.083	145.953	128.558	140.156
4	1.400	48.649	-122.306	-44.053	-80.462	-166.847	-76.615
5	1.800	59.340	-31.832	1.752	42.611	-126.816	37.832
6	2.200	64.039	-33.379	3.359	46.599	-117.683	52.759
7	2.600	82.710	-13.558	14.238	116.214	-95.378	66.724
8	3.000	116.905	60.128	-2.189	-138.057	-62.102	92.890
9	3.400	154.962	125.831	-34.391	-93.455	-26.438	132.398
10	3.800	1.065	162.127	-14.397	-57.924	-165.050	157.291
11	4.200	28.848	167.175	-3.688	-32.059	-145.129	174.313
12	4.600	44.255	155.782	-.309	-15.307	-130.167	-173.493
13	5.000	55.054	138.246	-.683	-1.195	-119.126	-163.831
14	5.400	62.891	126.053	-2.713	19.143	-110.743	-155.449
15	5.800	68.450	121.801	-5.018	106.865	-104.405	-147.210

RMS displacements and accelerations of ship-a
(Heading= 180.0(Deg.) average period T1=8.123(sec)

motion_mode j	Dj	Aj
1	.1481 (m)	.0067 (g)
2	.0368 (m)	.0046 (g)
3	.5168 (m)	.0309 (g)
4	.0175 (deg)	.0310 (deg/s^2)
5	1.2283 (deg)	.7257 (deg/s^2)
6	.0201 (deg)	.0395 (deg/s^2)

RMS displacements and accelerations of ship-b
(Heading= 180.0 (Deg.) average period T1=8.123 (sec)

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motion_mode j	Dj	Aj
1	.3162 (m)	.0263 (g)
2	.1649 (m)	.0249 (g)
3	.9569 (m)	.1279 (g)
4	2.3666 (deg)	2.0261 (deg/s^2)
5	2.9574 (deg)	4.7577 (deg/s^2)
6	.4594 (deg)	.6974 (deg/s^2)

nondimensional wave exciting forces on ship_a (Heading = 225.0 (Deg.)

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no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.00113	.00735	.00522	.00007	.00179	.00505
2	.60000	.00964	.03346	.01772	.00053	.00671	.00897
3	1.00000	.01690	.03755	.00644	.00060	.00610	.02257
4	1.40000	.01369	.07698	.06875	.00030	.00796	.01443
5	1.80000	.02622	.08835	.01454	.00030	.02428	.04493
6	2.20000	.05400	.22132	.10456	.00142	.04744	.05347
7	2.60000	.06803	.22205	.13615	.00143	.06227	.05479
8	3.00000	.07415	.22470	.18112	.00138	.06819	.05212
9	3.40000	.07569	.22247	.22346	.00130	.06976	.04729
10	3.80000	.07486	.21556	.26024	.00117	.06934	.04116
11	4.20000	.07307	.20694	.29196	.00104	.06811	.03475
12	4.60000	.07097	.19791	.31921	.00091	.06660	.02890
13	5.00000	.06882	.18886	.34262	.00081	.06501	.02393
14	5.40000	.06672	.17993	.36281	.00072	.06343	.01984
15	5.80000	.06469	.17126	.38038	.00065	.06188	.01652

phase angle (Deg.)of wave exciting forces on ship_a

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no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	-23.265	-109.204	-10.819	-33.316	5.549	-109.305
2	.600	126.335	97.925	174.401	76.248	152.986	17.382
3	1.000	120.159	75.588	-52.754	-164.853	109.055	163.447
4	1.400	90.252	71.971	-160.377	105.200	136.922	21.286
5	1.800	-64.365	-179.321	-87.485	-87.879	-80.619	-12.977
6	2.200	-72.748	-98.406	60.066	-51.706	-80.903	-19.148
7	2.600	-76.163	-87.755	48.464	-47.153	-77.914	-23.924
8	3.000	-78.431	-87.362	37.391	-48.943	-76.385	-24.574
9	3.400	-80.230	-87.268	31.002	-49.856	-75.943	-23.166
10	3.800	-81.944	-87.329	26.688	-50.212	-76.100	-20.804
11	4.200	-83.613	-87.502	23.534	-51.014	-76.510	-18.705
12	4.600	-85.149	-87.617	21.115	-52.505	-76.947	-17.401
13	5.000	-86.488	-87.614	19.177	-54.513	-77.294	-16.944
14	5.400	-87.607	-87.512	17.564	-56.801	-77.505	-17.215
15	5.800	-88.517	-87.352	16.179	-59.192	-77.572	-18.080

nondimensional wave exciting forces on ship_b (Heading = 225.0 (Deg.)

no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.01272	.03984	.04988	.00227	.02991	.01314
2	.60000	.04649	.03756	.20047	.00258	.04388	.05245
3	1.00000	.03929	.23034	.09458	.00366	.06345	.06020
4	1.40000	.05094	.26792	.26965	.00364	.07360	.04437
5	1.80000	.04942	.43448	.61857	.00132	.09318	.00541
6	2.20000	.08265	.23694	1.01084	.00089	.09674	.02038
7	2.60000	.08902	.07053	.83679	.00062	.10836	.00943
8	3.00000	.08105	.03471	.77405	.00042	.10628	.00457
9	3.40000	.07007	.03565	.76146	.00037	.09749	.00297
10	3.80000	.05971	.04020	.76060	.00038	.08687	.00261
11	4.20000	.05131	.04267	.75832	.00039	.07690	.00270
12	4.60000	.04497	.04331	.75193	.00040	.06849	.00292
13	5.00000	.04028	.04280	.74225	.00040	.06174	.00314
14	5.40000	.03676	.04162	.73085	.00040	.05644	.00332
15	5.80000	.03406	.04008	.71906	.00039	.05228	.00344

phase angle (Deg.)of wave exciting forces on ship_b

no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	-52.428	-50.637	-47.457	33.343	-67.265	-24.916
2	.600	136.472	158.140	30.363	-157.633	115.891	-111.971
3	1.000	45.334	21.302	98.108	80.862	34.300	94.872
4	1.400	-15.113	-3.196	82.822	82.576	-7.038	86.166
5	1.800	-35.559	12.380	33.618	151.917	-20.509	63.932
6	2.200	-71.692	86.396	65.200	37.308	-39.085	64.876
7	2.600	-62.644	126.568	68.552	71.099	-37.792	95.651
8	3.000	-58.397	175.560	62.422	71.606	-32.620	108.341
9	3.400	-56.643	-147.118	56.866	67.657	-27.650	118.273
10	3.800	-57.106	-130.982	52.938	69.800	-23.962	129.528
11	4.200	-59.313	-122.873	50.130	75.166	-21.678	139.606
12	4.600	-62.567	-117.982	47.920	81.151	-20.549	147.184
13	5.000	-66.231	-114.683	45.983	86.726	-20.229	152.623
14	5.400	-69.885	-112.314	44.155	91.593	-20.409	156.526
15	5.800	-73.318	-110.556	42.366	95.735	-20.863	159.349

nondimensional transfer function: motion dispt. amplitudes on ship_a

Heading = 225.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.00007	.00045	.00013	.00002	.00001	.00005
2	.600	.00310	.01328	.00507	.00183	.00083	.00120
3	1.000	.01133	.01211	.00274	.00759	.00242	.01088
4	1.400	.01704	.09680	.08787	.01589	.01383	.01481
5	1.800	.03368	.03043	.03800	.01074	.09318	.05598
6	2.200	.04467	.06519	.43635	.03135	.37391	.11025
7	2.600	.05528	.12246	1.25678	.05093	.78461	.14508
8	3.000	.14223	.16439	1.28269	.06926	1.00685	.19319
9	3.400	.23771	.23621	1.06816	.08988	1.01144	.22724
10	3.800	.30268	.30397	.99663	.10508	.98687	.24363
11	4.200	.35324	.34971	.95551	.11747	.96656	.25714
12	4.600	.39003	.38104	.92904	.12849	.93877	.26938
13	5.000	.41331	.40418	.91928	.13860	.90201	.28003
14	5.400	.42570	.42260	.92351	.14807	.86060	.28897

15	5.800	.43069	.43806	.93612	.15710	.81931	.29630

phase angle(Deg.) of motions of ship_a:

Heading = 225.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	148.042	78.500	78.500	78.500	78.500	78.500
2	.600	-53.600	-80.247	24.842	-96.996	-19.827	-168.319
3	1.000	-53.353	-130.913	170.623	48.310	-46.569	-2.281
4	1.400	-101.581	-79.665	29.312	-44.943	-41.280	-112.666
5	1.800	151.118	-52.716	54.980	-106.066	120.688	-166.109
6	2.200	137.714	89.082	-110.739	-164.646	147.756	-170.741
7	2.600	79.178	96.442	-57.422	-169.435	-179.003	-175.064
8	3.000	56.714	87.694	-16.394	-178.241	-147.369	-179.197
9	3.400	66.433	81.086	-5.444	-179.650	-127.511	-176.171
10	3.800	73.965	83.136	-2.785	-179.179	-116.446	-175.361
11	4.200	79.796	85.829	-1.700	-178.822	-108.461	-175.789
12	4.600	84.967	87.625	-1.990	-178.343	-102.011	-176.339
13	5.000	89.399	88.657	-3.018	-177.634	-96.883	-176.771
14	5.400	92.941	89.208	-4.109	-176.688	-93.015	-177.087
15	5.800	95.586	89.487	-4.902	-175.533	-90.273	-177.336

nondimensional transfer function: motion dispt. amplitudes on ship_b

Heading = 225.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.00141	.00780	.00406	.00323	.00187	.00106
2	.600	.03908	.05488	.13432	.03647	.07248	.07106
3	1.000	.01646	.39363	.55851	.19449	.44958	.21954
4	1.400	.14173	.61973	.78047	.60403	.72753	.24153
5	1.800	.30915	.73312	1.12304	1.15743	.96546	.27277
6	2.200	.58704	.35306	1.48691	1.27863	1.43587	.08355
7	2.600	.68073	.32740	1.04571	2.26476	1.38768	.23379
8	3.000	.44533	.54223	.89242	1.68880	.82154	.42979
9	3.400	.07280	.48142	1.19344	1.32033	.11932	.44785
10	3.800	.19074	.48619	1.14679	1.09041	.34568	.42691
11	4.200	.33357	.50710	1.04768	.91222	.56851	.39869
12	4.600	.40659	.52785	.97382	.78470	.67317	.37070
13	5.000	.43652	.54640	.93560	.68937	.71033	.34471
14	5.400	.44066	.56141	.92668	.61391	.70934	.32128
15	5.800	.43089	.57251	.93594	.55174	.68853	.30046

phase angle(Deg.) of motions of ship_b:

Heading = 225.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	146.537	131.881	140.591	-141.575	107.383	158.498
2	.600	-12.672	-92.423	-114.287	69.655	-52.190	77.352
3	1.000	36.369	-145.477	22.096	-46.494	-77.784	-65.357
4	1.400	126.993	173.872	75.252	-66.826	-57.226	-85.997
5	1.800	112.137	-161.540	33.582	-21.186	-69.078	-75.023
6	2.200	120.427	-126.248	44.838	75.147	-56.284	-46.618
7	2.600	153.760	95.465	60.256	-83.409	-22.629	130.084
8	3.000	-173.037	128.614	23.530	9.029	9.394	175.806
9	3.400	-154.728	130.565	27.053	34.485	16.698	-167.132
10	3.800	67.100	124.082	32.174	52.300	-104.472	-159.387
11	4.200	76.841	119.803	31.809	63.439	-95.283	-155.878

12	4.600	84.673	116.859	28.455	70.976	-86.964	-154.452
13	5.000	90.242	114.836	23.946	76.639	-80.494	-154.214
14	5.400	93.780	113.462	19.583	81.185	-75.722	-154.695
15	5.800	95.522	112.483	16.023	84.972	-72.429	-155.574

RMS displacements and accelerations of ship-a
(Heading= 225.0(Deg.) average period T1=8.123(sec)

motion_mode j	Dj	Aj
1	.1711(m)	.0076(g)
2	.1774(m)	.0094(g)
3	.7284(m)	.0432(g)
4	.1209(deg)	.1026(deg/s^2)
5	1.3026(deg)	.7922(deg/s^2)
6	.3065(deg)	.2420(deg/s^2)

RMS displacements and accelerations of ship-b
(Heading= 225.0(Deg.) average period T1=8.123(sec)

motion_mode j	Dj	Aj
1	.3471(m)	.0278(g)
2	.4495(m)	.0538(g)
3	.9522(m)	.0892(g)
4	3.1211(deg)	3.4520(deg/s^2)
5	2.6482(deg)	5.8255(deg/s^2)
6	.8263(deg)	1.8438(deg/s^2)

nondimensional wave exciting forces on ship_a (Heading = 270.0 (Deg.)

no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.00473	.02732	.01310	.00016	.00196	.00536
2	.60000	.00561	.17681	.09982	.00056	.00819	.02536
3	1.00000	.01119	.34433	.15167	.00172	.00618	.03014
4	1.40000	.01323	.53587	.29479	.00207	.00535	.03320
5	1.80000	.01519	.52728	.32836	.00196	.00169	.03305
6	2.20000	.01506	.48980	.34660	.00176	.00273	.02803
7	2.60000	.01430	.44354	.35546	.00151	.00512	.02279
8	3.00000	.01347	.40453	.36313	.00129	.00712	.01905
9	3.40000	.01265	.37173	.37189	.00112	.00875	.01665
10	3.80000	.01185	.34294	.38179	.00099	.01007	.01511
11	4.20000	.01112	.31720	.39236	.00088	.01113	.01404
12	4.60000	.01045	.29414	.40316	.00079	.01199	.01323
13	5.00000	.00985	.27352	.41388	.00072	.01270	.01258
14	5.40000	.00932	.25513	.42432	.00066	.01329	.01204
15	5.80000	.00884	.23874	.43437	.00060	.01378	.01156

phase angle (Deg.)of wave exciting forces on ship_a

no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	-6.992	177.946	-39.606	26.971	-1.421	48.626
2	.600	-159.845	-79.308	105.308	-124.662	87.319	-156.907
3	1.000	-169.392	-117.305	61.061	-139.628	74.836	-171.544
4	1.400	-163.699	-108.441	61.667	-121.180	94.678	-173.566
5	1.800	-153.467	-104.410	57.251	-121.228	66.743	-161.836
6	2.200	-142.916	-100.530	52.024	-116.583	-20.208	-152.273
7	2.600	-135.251	-98.491	46.602	-113.568	-30.107	-148.370

8	3.000	-129.232	-97.299	41.289	-112.276	-30.852	-148.622
9	3.400	-124.226	-96.226	36.463	-111.852	-29.725	-150.667
10	3.800	-120.029	-95.159	32.255	-111.840	-28.133	-152.996
11	4.200	-116.513	-94.153	28.654	-112.059	-26.534	-155.035
12	4.600	-113.560	-93.257	25.591	-112.434	-25.078	-156.689
13	5.000	-111.066	-92.491	22.983	-112.928	-23.799	-158.016
14	5.400	-108.944	-91.851	20.752	-113.513	-22.689	-159.096
15	5.800	-107.126	-91.324	18.832	-114.167	-21.727	-159.994

nondimensional wave exciting forces on ship_b (Heading = 270.0 (Deg.)

no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.03565	.13360	.13982	.00043	.04343	.02596
2	.60000	.02715	.29324	.38371	.00059	.00271	.02194
3	1.00000	.01695	.50287	.25367	.00336	.00587	.03110
4	1.40000	.03138	.44536	.64670	.00321	.01540	.03242
5	1.80000	.03285	.21278	.81434	.00164	.03256	.01604
6	2.20000	.03043	.09703	.93150	.00071	.03731	.00697
7	2.60000	.02821	.03963	.98024	.00033	.03826	.00240
8	3.00000	.02584	.03238	.97956	.00041	.03793	.00281
9	3.40000	.02356	.04161	.95408	.00053	.03693	.00422
10	3.80000	.02153	.04776	.91843	.00061	.03563	.00514
11	4.20000	.01978	.05041	.88058	.00064	.03427	.00568
12	4.60000	.01830	.05085	.84468	.00066	.03301	.00597
13	5.00000	.01706	.05004	.81260	.00066	.03189	.00610
14	5.40000	.01601	.04856	.78493	.00065	.03096	.00614
15	5.80000	.01513	.04677	.76161	.00063	.03019	.00611

phase angle (Deg.)of wave exciting forces on ship_b

no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	76.970	147.015	-29.297	-16.056	77.470	40.294
2	.600	166.700	-169.455	2.235	87.575	-47.734	118.753
3	1.000	69.941	58.395	-93.630	-71.118	92.677	-4.574
4	1.400	-76.077	72.838	104.457	-67.795	23.520	2.120
5	1.800	-67.812	64.378	94.501	-77.227	40.329	-4.599
6	2.200	-73.486	54.455	84.890	-92.281	45.904	-14.562
7	2.600	-77.851	22.676	79.733	-143.237	46.655	-57.345
8	3.000	-81.018	-35.138	76.119	166.723	46.103	-130.762
9	3.400	-83.817	-60.216	73.009	151.472	45.085	-150.118
10	3.800	-86.532	-69.330	70.036	145.764	43.690	-156.989
11	4.200	-89.236	-73.769	67.069	143.041	41.962	-160.635
12	4.600	-91.932	-76.449	64.082	141.521	39.977	-163.053
13	5.000	-94.604	-78.332	61.093	140.563	37.830	-164.895
14	5.400	-97.229	-79.801	58.138	139.895	35.607	-166.427
15	5.800	-99.786	-81.031	55.256	139.392	33.379	-167.769

nondimensional transfer function: motion dispt. amplitudes on ship_a

Heading = 270.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.00126	.00721	.00149	.00014	.00006	.00018
2	.600	.00646	.18714	.07954	.00728	.00512	.00605
3	1.000	.02464	.36525	.29674	.01908	.00815	.01250
4	1.400	.06100	.47790	.94009	.02986	.04112	.01486
5	1.800	.10322	.57021	1.39690	.03706	.12619	.00900
6	2.200	.10364	.67204	1.40534	.03635	.11644	.00763

7	2.600	.09921	.71231	1.24594	.03419	.11378	.01182
8	3.000	.10769	.73870	1.14350	.02951	.12848	.01229
9	3.400	.11769	.76136	1.09650	.02338	.14062	.01183
10	3.800	.12513	.78103	1.07774	.01821	.14746	.01108
11	4.200	.12964	.79786	1.07091	.01871	.15009	.01023
12	4.600	.13193	.81210	1.06828	.02685	.15001	.00948
13	5.000	.13276	.82407	1.06672	.03954	.14841	.00902
14	5.400	.13270	.83413	1.06517	.05475	.14603	.00906
15	5.800	.13217	.84258	1.06340	.07177	.14334	.00978

phase angle(Deg.) of motions of ship_a:

Heading = 270.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	173.128	2.978	137.517	-147.288	-147.288	-122.958
2	.600	24.408	116.113	-74.634	99.722	-85.063	35.817
3	1.000	49.170	109.311	-92.723	107.353	-95.793	59.649
4	1.400	75.682	99.710	-79.078	98.782	-108.602	85.413
5	1.800	121.036	91.821	-42.303	99.078	-52.790	129.085
6	2.200	156.858	91.418	-20.237	101.521	-10.058	67.959
7	2.600	168.996	92.061	-9.758	104.756	-2.036	92.155
8	3.000	177.248	91.657	-6.749	112.004	7.015	109.905
9	3.400	-173.700	91.133	-5.979	125.316	17.729	121.259
10	3.800	-164.957	90.714	-5.640	151.263	27.791	127.781
11	4.200	-157.264	90.418	-5.264	-169.892	36.489	129.896
12	4.600	-150.805	90.221	-4.811	-141.147	43.769	127.624
13	5.000	-145.504	90.091	-4.332	-126.418	49.789	121.109
14	5.400	-141.202	90.008	-3.870	-118.491	54.756	111.335
15	5.800	-137.732	89.954	-3.448	-113.714	58.865	100.433

nondimensional transfer function: motion dispt. amplitudes on ship_b

Heading = 270.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.02032	.10214	.06736	.00203	.01448	.00693
2	.600	.11401	.23797	1.61743	.12113	.13503	.03370
3	1.000	.02184	1.19967	.82261	.78881	.03304	.06334
4	1.400	.14394	.54901	1.63464	1.30923	.26501	.04047
5	1.800	.36731	.37175	1.69910	1.74809	.55441	.12450
6	2.200	.34295	.81283	1.31160	2.09657	.40493	.12923
7	2.600	.23498	.92740	.91479	1.64106	.22166	.10061
8	3.000	.15935	.94650	.81989	1.32643	.13714	.08129
9	3.400	.09942	.95528	.83075	1.13738	.11075	.06894
10	3.800	.04786	.96154	.86959	1.01148	.11466	.06078
11	4.200	.00602	.96526	.91089	.91908	.12738	.05556
12	4.600	.03732	.96688	.94633	.84652	.13999	.05278
13	5.000	.07142	.96710	.97425	.78682	.15042	.05232
14	5.400	.10151	.96648	.99542	.73600	.15868	.05432
15	5.800	.12828	.96537	1.01121	.69153	.16520	.05894

phase angle(Deg.) of motions of ship_b:

Heading = 270.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	-76.262	-25.616	148.438	80.811	-82.551	-131.582
2	.600	82.826	-10.439	-75.991	102.347	-77.676	28.236
3	1.000	-53.690	-62.930	109.238	122.072	135.482	-60.404

4	1.400	-108.918	-76.827	100.108	154.890	88.299	-97.750
5	1.800	-24.891	156.046	98.030	59.318	157.486	-140.084
6	2.200	44.736	146.509	101.796	112.723	-137.615	-100.406
7	2.600	79.741	146.066	86.053	129.434	-95.688	-87.701
8	3.000	99.536	141.775	66.176	131.963	-56.766	-84.752
9	3.400	114.258	137.061	51.804	130.889	-15.272	-84.011
10	3.800	128.139	132.954	42.329	129.078	17.984	-83.115
11	4.200	-163.754	129.501	36.058	127.278	40.006	-80.988
12	4.600	-52.213	126.574	31.751	125.683	54.696	-77.086
13	5.000	-42.919	124.058	28.636	124.345	65.068	-71.394
14	5.400	-37.404	121.874	26.261	123.273	72.755	-64.455
15	5.800	-33.344	119.961	24.363	122.461	78.659	-57.134

RMS displacements and accelerations of ship-a
(Heading= 270.0(Deg.) average period T1=8.123(sec)

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motion_mode j	Dj	Aj
1	.0911(m)	.0043(g)
2	.5951(m)	.0306(g)
3	1.0066(m)	.0539(g)
4	.0914(deg)	.0780(deg/s^2)
5	.2700(deg)	.1505(deg/s^2)
6	.0400(deg)	.0445(deg/s^2)

RMS displacements and accelerations of ship-b
(Heading= 270.0(Deg.) average period T1=8.123(sec)

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motion_mode j	Dj	Aj
1	.1907(m)	.0135(g)
2	.7718(m)	.0537(g)
3	1.0922(m)	.1145(g)
4	4.3148(deg)	4.2142(deg/s^2)
5	1.0329(deg)	1.6477(deg/s^2)
6	.2771(deg)	.2651(deg/s^2)

nondimensional wave exciting forces on ship_a (Heading = 315.0 (Deg.)

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no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.00181	.00199	.00347	.00006	.00148	.00190
2	.60000	.00678	.01910	.02050	.00022	.00526	.00664
3	1.00000	.01558	.04716	.05639	.00082	.02113	.02330
4	1.40000	.03167	.09041	.11506	.00028	.03044	.00338
5	1.80000	.02037	.02895	.13734	.00053	.02550	.03218
6	2.20000	.02744	.04942	.13021	.00080	.03191	.04263
7	2.60000	.03973	.09053	.13372	.00086	.04166	.04367
8	3.00000	.04812	.11448	.15679	.00083	.04895	.04116
9	3.40000	.05295	.12671	.18962	.00076	.05351	.03764
10	3.80000	.05533	.13178	.22408	.00070	.05600	.03407
11	4.20000	.05613	.13262	.25674	.00063	.05708	.03079
12	4.60000	.05593	.13101	.28655	.00058	.05720	.02791
13	5.00000	.05510	.12801	.31337	.00053	.05670	.02540
14	5.40000	.05390	.12427	.33740	.00048	.05581	.02323
15	5.80000	.05247	.12019	.35895	.00045	.05467	.02136

phase angle (Deg.)of wave exciting forces on ship_a

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no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6

1	.200	96.893	95.702	125.180	106.683	76.157	107.166
2	.600	-99.460	24.599	-160.191	99.757	-131.208	114.567
3	1.000	-31.281	97.219	-70.105	-31.948	-28.079	-16.290
4	1.400	-102.944	69.070	-159.986	12.323	-108.024	160.826
5	1.800	-159.556	36.837	162.900	146.038	-167.875	169.055
6	2.200	139.016	-75.572	130.235	160.134	143.247	171.952
7	2.600	117.731	-85.978	97.294	166.924	120.137	173.872
8	3.000	108.727	-88.159	71.494	171.550	108.224	175.238
9	3.400	103.802	-88.794	54.595	175.078	100.967	176.272
10	3.800	100.721	-88.956	43.635	177.926	96.017	177.095
11	4.200	98.639	-88.949	36.156	-179.694	92.365	177.777
12	4.600	97.160	-88.883	30.769	-177.657	89.508	178.362
13	5.000	96.070	-88.800	26.711	-175.884	87.168	178.874
14	5.400	95.244	-88.719	23.544	-174.322	85.180	179.330
15	5.800	94.602	-88.645	21.003	-172.933	83.438	179.743

nondimensional wave exciting forces on ship_b (Heading = 315.0 (Deg.)

no.	Lamda/Lb	f1	f2	f3	f4	f5	f6
1	.20000	.00575	.00329	.01525	.00097	.00610	.00154
2	.60000	.01020	.03119	.15074	.00237	.01537	.02086
3	1.00000	.04372	.09354	.25298	.00263	.07981	.02645
4	1.40000	.05775	.08536	.43491	.00198	.09885	.01876
5	1.80000	.05603	.06882	.53126	.00149	.09286	.01356
6	2.20000	.04849	.05696	.59173	.00122	.07928	.01085
7	2.60000	.04066	.05059	.62594	.00106	.06724	.00943
8	3.00000	.03425	.04689	.64123	.00097	.05855	.00857
9	3.40000	.02936	.04413	.64549	.00090	.05257	.00796
10	3.80000	.02571	.04170	.64435	.00084	.04836	.00747
11	4.20000	.02295	.03943	.64115	.00079	.04528	.00706
12	4.60000	.02083	.03729	.63767	.00074	.04289	.00670
13	5.00000	.01917	.03529	.63471	.00070	.04097	.00639
14	5.40000	.01784	.03343	.63261	.00066	.03938	.00611
15	5.80000	.01675	.03171	.63143	.00063	.03804	.00586

phase angle (Deg.)of wave exciting forces on ship_b

no.	Lamda/Lb	pf1	pf2	pf3	pf4	pf5	pf6
1	.200	-142.262	100.592	155.391	-153.247	-151.691	-169.964
2	.600	179.056	139.043	64.316	94.631	100.325	33.646
3	1.000	-112.843	39.298	-131.556	-54.322	-108.815	-48.557
4	1.400	-147.708	-.212	154.990	-108.282	-157.503	-86.235
5	1.800	-163.871	-22.759	121.236	-141.234	177.959	-111.235
6	2.200	-172.596	-41.203	101.192	-164.846	161.074	-130.382
7	2.600	-178.996	-55.718	88.294	178.219	146.671	-144.378
8	3.000	175.528	-66.048	79.077	166.349	133.876	-154.226
9	3.400	170.662	-73.194	71.868	158.010	122.700	-161.195
10	3.800	166.385	-78.239	65.879	152.030	113.108	-166.271
11	4.200	162.719	-81.940	60.718	147.625	104.914	-170.104
12	4.600	159.661	-84.764	56.180	144.293	97.873	-173.099
13	5.000	157.173	-86.997	52.146	141.715	91.754	-175.512
14	5.400	155.198	-88.816	48.537	139.680	86.365	-177.506
15	5.800	153.669	-90.335	45.295	138.048	81.559	-179.191

nondimensional transfer function: motion dispt. amplitudes on ship_a

Heading = 315.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.04945	.03544	.00471	.00807	.00040	.00440
2	.600	.02417	.03627	.08231	.00563	.00813	.00611
3	1.000	.08947	.03679	.05492	.03942	.07037	.02446
4	1.400	.19131	.08799	.20051	.02614	.14453	.02593
5	1.800	.20876	.03794	.22944	.03268	.17181	.12174
6	2.200	.31442	.14901	.24638	.08653	.24461	.20258
7	2.600	.44241	.25826	.32903	.12975	.33692	.26167
8	3.000	.55098	.34582	.43033	.16419	.41970	.30380
9	3.400	.63521	.41388	.52172	.19268	.48691	.33406
10	3.800	.69883	.46657	.59760	.21738	.53992	.35614
11	4.200	.74662	.50757	.65921	.23982	.58156	.37255
12	4.600	.78254	.53975	.70913	.26104	.61443	.38497
13	5.000	.80965	.56522	.74981	.28177	.64060	.39452
14	5.400	.83018	.58558	.78325	.30249	.66165	.40198
15	5.800	.84573	.60197	.81099	.32359	.67874	.40790

phase angle(Deg.) of motions of ship_a:

Heading = 315.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	-85.336	-109.209	136.766	-44.038	69.306	-61.013
2	.600	61.186	-67.512	-162.149	-55.026	-153.739	-68.132
3	1.000	94.350	-64.554	-174.452	143.205	-72.234	168.761
4	1.400	30.030	-97.559	113.502	140.184	-148.458	-11.861
5	1.800	-24.037	158.777	88.761	-17.480	161.572	-8.056
6	2.200	-60.717	106.375	52.918	-23.317	126.730	-6.549
7	2.600	-75.679	98.864	27.372	-25.282	110.537	-5.607
8	3.000	-82.430	95.762	15.238	-27.127	102.802	-4.932
9	3.400	-85.971	94.066	9.303	-29.133	98.645	-4.398
10	3.800	-88.052	93.013	6.069	-31.295	96.178	-3.941
11	4.200	-89.387	92.308	4.137	-33.565	94.595	-3.526
12	4.600	-90.308	91.809	2.899	-35.893	93.517	-3.130
13	5.000	-90.982	91.442	2.062	-38.239	92.744	-2.741
14	5.400	-91.503	91.161	1.472	-40.567	92.167	-2.350
15	5.800	-91.924	90.941	1.042	-42.853	91.720	-1.952

nondimensional transfer function: motion dispt. amplitudes on ship_b

Heading = 315.0 (Deg.)

no.	Lamda/Lb	y1/a	y2/a	y3/a	y4/ka	y5/ka	y6/ka
1	.200	.45992	.22591	.01777	.03692	.00306	.04979
2	.600	.23060	.21944	.40060	.70229	.07104	.18789
3	1.000	.99837	.50486	.51333	.74227	.42468	.29463
4	1.400	1.43117	.54422	1.01047	.62288	.72334	.27606
5	1.800	1.37827	.52308	1.09299	.51538	.77345	.25426
6	2.200	1.22452	.56936	1.03958	.50679	.73709	.25777
7	2.600	1.10884	.63426	.99062	.52466	.70393	.26993
8	3.000	1.04198	.68836	.96619	.53708	.69056	.28189
9	3.400	1.00720	.72751	.95862	.54007	.69144	.29198
10	3.800	.98988	.75440	.95973	.53583	.69942	.30071
11	4.200	.98137	.77237	.96466	.52680	.70997	.30879
12	4.600	.97714	.78403	.97097	.51479	.72082	.31687
13	5.000	.97498	.79124	.97752	.50098	.73098	.32539
14	5.400	.97381	.79532	.98380	.48613	.74009	.33464
15	5.800	.97311	.79716	.98960	.47075	.74808	.34482

phase angle(Deg.) of motions of ship_b:

Heading = 315.0 (Deg.)

no.	Lamda/Lb	pm1	pm2	pm3	pm4	pm5	pm6
1	.200	36.449	-89.405	145.581	-149.285	-150.677	7.381
2	.600	-51.281	-21.858	26.039	93.287	111.688	-149.775
3	1.000	52.304	-124.741	151.672	-46.571	-119.960	130.658
4	1.400	14.709	-155.728	99.246	-102.062	-162.167	98.394
5	1.800	-.617	174.025	82.575	-143.710	179.928	71.249
6	2.200	-12.303	150.882	70.007	-173.976	166.121	51.029
7	2.600	-22.683	137.040	59.049	167.562	153.885	37.953
8	3.000	-31.391	128.704	49.962	156.137	143.592	29.456
9	3.400	-38.210	123.262	42.749	148.577	135.428	23.640
10	3.800	-43.340	119.430	37.095	143.285	129.125	19.461
11	4.200	-47.135	116.569	32.635	139.445	124.267	16.346
12	4.600	-49.928	114.340	29.066	136.604	120.482	13.968
13	5.000	-51.978	112.545	26.161	134.492	117.483	12.122
14	5.400	-53.477	111.065	23.761	132.940	115.067	10.675
15	5.800	-54.562	109.822	21.747	131.836	113.088	9.531

RMS displacements and accelerations of ship-a
(Heading= 315.0(Deg.) average period T1=8.123(sec)

motion_mode j	Dj	Aj
1	.4359(m)	.0095(g)
2	.2801(m)	.0058(g)
3	.3743(m)	.0082(g)
4	.2798(deg)	.0696(deg/s^2)
5	.7371(deg)	.1892(deg/s^2)
6	.4983(deg)	.1221(deg/s^2)

RMS displacements and accelerations of ship-b
(Heading= 315.0(Deg.) average period T1=8.123(sec)

motion_mode j	Dj	Aj
1	1.0133(m)	.0304(g)
2	.5686(m)	.0151(g)
3	.8569(m)	.0240(g)
4	2.7791(deg)	1.0932(deg/s^2)
5	2.0468(deg)	.6763(deg/s^2)
6	.9996(deg)	.3742(deg/s^2)

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SECURITY CLASSIFICATION OF FORM
(highest classification of Title, Abstract, Keywords)

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User's Guide for SHIPINT - A Computer Program to Compute Two Ship Interaction in Waves

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Hsiung, C.C. and He, Y.J.

5. DATE OF PUBLICATION (month and year of publication of document) August 1996	6a. NO OF PAGES (total containing information. Include Annexes, Appendices, etc.). 79	6b. NO. OF REFS (total cited in document) 5

7. DESCRIPTIVE NOTES (the category of the document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of report, e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered).

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9a. PROJECT OR GRANT NO. (if appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant). 1.g.b	9b. CONTRACT NO. (if appropriate, the applicable number under which the document was written). W7707-5-3254/01-HAL
10a ORIGINATOR'S DOCUMENT NUMBER (the official document number by which the document is identified by the originating activity. This number must be unique to this document). Technical Report CMVDR-96-4	10b OTHER DOCUMENT NOS. (Any other numbers which may be assigned this document either by the originator or by the sponsor). DREA CR/96/445

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The computer program SHIPINT was developed for the coupled motion computations of two adjacent ships advancing on a parallel course in regular or irregular waves. The code is written in Fortran 77 ANSI.

The coupled motion computations use the three-dimensional panel method, and the zero-speed Green function with a simple forward speed correction. With this method, the field points and source points are all distributed on the wetted surfaces of two ships (ship-a and ship-b). The hydrodynamic forces, wave exciting forces and motions are computed based on two ship interaction. The double body flow model is applied to obtain the steady flow disturbance potential and velocity distributions on the wetted surface on ship-a and ship-b by the Hess-Smith method. The m-terms are computed by the integral equation method based on double body flow of two ship interaction. The approximate m-terms can also be used in this program. Schmitke's method is used to compute the viscous roll damping coefficients for ship-a on its own, and ship-b on its own; therefore, the viscous interaction effect is not considered. The spectral analyses are carried out for ship-a and ship-b.

Input and output files, and examples are also presented and described in detail in this guide.

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